Notice No. 11

Rules and Regulations for the Classification of Ships, July 2014

The status of this Rule set is amended as shown and is now to be read in conjunction with this and prior Notices. Any corrigenda included in the Notice are effective immediately.

Issue date: May 2015

Amendments to	Effective date
Part 1, Chapter 2, Section 2	1 July 2015
Part 1, Chapter 3, Section 17	1 July 2015
Part 4, Chapter 2, Section 11	1 July 2015
Part 5, Chapter 1, Section 6	1 July 2015
Part 5, Chapter 2, Scope, Sections 1, 2, 3, 4, 7, 8, 10, 11, 12, 13, 14, 15, 16, 17, 18 & 19	1 July 2015
Part 5, Chapter 6, Sections 3 & 4	1 July 2015
Part 5, Chapter 8, Section 5	1 July 2015
Part 5, Chapter 9, Sections 3 & 6	1 July 2015
Part 5, Chapter 10, Section 15	1 July 2015
Part 5, Chapter 12, Section 4	1 July 2015
Part 5, Chapter 13, Section 7	1 July 2015
Part 5, Chapter 16, Section 3	1 July 2015
Part 5, Chapter 19, Sections 1, 2, 5 & 6	1 July 2015
Part 5, Chapter 20, Section 2	1 July 2015
Part 5, Chapter 24, Section 5	1 July 2015
Part 6, Chapter 2, Sections 1, 6, 7, 10, 11 & 23	1 July 2015
Part 7, Chapter 11, Sections 1, 2 & 3	1 July 2015

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Part 1, Chapter 2

Classification Regulations

Effective date 1 July 2015

■ *Section 2*
Character of classification and class notations

2.1 Definitions

Table 2.2.2 Special features notations

Special features notation	Description	*See also*
ELD	Assigned when ergonomic lighting design has been applied	Pt 6, Ch 2,23 and Pt 16, Ch 2,22

Part 1, Chapter 3

Periodical Survey Regulations

Effective date 1 July 2015

■ *Section 17*
Screwshafts, tube shafts and propellers

17.3 Screwshaft Condition Monitoring (SCM)

~~*17.3.1* Where oil lubricated shafts with approved oil glands are fitted or where water lubricated sternbush bearings are fitted, and the Owner has complied with the requirements of 17.3.2 or 17.3.4, the ShipRight descriptive note **SCM** (Screwshaft Condition Monitoring) may be entered in column 6 of the *Register Book*.~~

17.3.1 Monitoring records are to be reviewed at annual survey for all vessels assigned the ShipRight descriptive note SCM (Screwshaft Condition Monitoring). The records that are to be maintained for oil and water lubricated bearings are detailed in the following sections.

17.3.2 Oil lubricated bearing~~s~~ records are to be available on board that include the following:

(a) Lubricating oil analysis is to be carried out regularly at intervals not exceeding six months. ~~The lubricating oil analysis documentation is to be available on board.~~ Each analysis is to include the following minimum parameters:
- water content,
- chloride content,
- bearing material and metal particles content,
- oil ageing (resistance to oxidation), minimum testing to include Viscosity and Total Acid Number (TAN).

~~(b)~~NOTE Oil samples are to be taken under service conditions and are to be representative of the oil within the sterntube.

(~~c~~b) Oil consumption ~~is to be recorded~~.

(~~d~~c) Bearing temperatures ~~are to be recorded (two temperature sensors or other approved arrangements are to be provided)~~.

~~(e) Facilities are to be provided for measurement of bearing weardown.~~

~~(f) Oil glands are to be capable of being replaced without withdrawal of the screwshaft.~~

17.3.4 Water lubricated bearing~~s~~ records are to be available on board that include the following:

(a) A ~~means of monitoring and recording~~ record of variations in the flow rate of lubricating water ~~using two independent sensors is to be provided~~.

(b) A ~~means of monitoring and recording~~ record of variations in the shaft power transmission ~~is to be provided~~.

(c) ~~A maximum permitted weardown of the sternbush is to be established and approved wear monitoring equipment is to be fitted. The weardown allowance is to include both the absolute maximum allowable weardown and the weardown at which it is recommended to carry out an inspection and maintenance. An alignment analysis considering both the newly installed clearance and the proposed absolute maximum allowable weardown, demonstrating that the system will operate satisfactorily within these two limits, is to be submitted and approved.~~ Wear monitoring records for the sternbush.

(d) For open loop systems ~~the manufacturer is to submit information regarding the required standard of lubricating water filtration and lubricating water filters or separators are to be fitted which are able to achieve this requirement:~~ the records from equipment for continuous monitoring of water sediment or alternatively records from a LR approved extractive sampling and testing procedure are to be available on board.

- ~~The lubricating water supply is to be fitted with continuous water sediment measuring or turbidity monitoring equipment. The results are to be recorded and retained on board and made available to LR on request, alternatively, there is to be a LR approved extractive sampling and testing procedure with the records held on board and made available to LR on request.~~

Records of cleaning and replacement of lubrication filters/separators are to be maintained on board. The pumping and water filtration system is to be considered part of the continuous survey cycle and is to be subject to a Periodical Survey.

(e) ~~Where a~~ For closed cycle water systems ~~is used, the pumping and water filtration systems are to be considered part of the continuous survey cycle and are to be subject to a Periodical Survey. Water analysis is to be carried out~~ the records from water analysis results carried out regularly at intervals not exceeding six months are to be retained on board. ~~Samples are to be taken under service conditions and are to be representative of the water circulating within the sterntube. Analysis results are to be retained on board and made available to LR on request.~~ The analysis is to include the following parameters:

(i) Chloride content.

(ii) Bearing material and metal particles content.

~~(f) The shaft is to either be constructed of corrosion resistant material or protected with a corrosion resistant protective liner or coating approved by LR. Where a protective liner or coating is used, this is to meet the requirements of Pt 5, Ch 6,3.9 and a means of assessing the condition of this liner is to be submitted and approved.~~

~~(g) Glands are to be capable of being replaced without withdrawal of the screwshaft.~~

~~(h) There is to be a shaft starting/clutch engagement block to inhibit starting the shaft until lubricating water flow has been established. This is to only act as a starting block; for lubricating water flow alarm *see* Table 3.17.1.~~

~~(j) Alternative arrangements are subject to specialconsieation. The means of monitoring and recording lubricating water flow and shaft power variation are to be submitted for approval.~~

NOTE Samples are to be taken under service conditions and are to be representative of the water circulating within the sterntube.

Records of cleaning and replacement of lubrication filters/separators are to be maintained on board. The pumping and water filtration system is to be considered part of the continuous survey cycle and is to be subject to a Periodical Survey.

~~Table 3.17.1 Alarm and safeguard for water lubricated bearings~~

Item	Alarm	Note
~~Lubricating water flow~~	Low	After the shaft start

17.3.6 Where the requirements for the descriptive note SCM have been complied with, the screwshaft need not be withdrawn at surveys as required by 17.2.1, provided all condition monitoring data are found to be within permissible limits and all exposed areas of the shaft are examined by a magnetic particle crack detection method or an alternative approved means for shafts with a protective liner or coating ~~(17.3.4(f))~~ (Pt 5, Ch 6, 4.1.3(f)). The remaining requirements of 17.2.1 are to be complied with. Where the Attending Surveyor considers that the data presented is not sufficient to determine the condition of the shaft, the shaft may be required to be withdrawn in accordance with 17.2.1. For water lubricated bearings, the screwshaft is to be withdrawn for examination, as 17.2.1, when the ship reaches 18 years from the date of build or the third Special Survey, whichever comes first.

Part 4, Chapter 2

Ferries, Roll on–Roll off Ships and Passenger Ships

Effective date 1 July 2015

■ *Section 11*
Miscellaneous openings

11.2 Openings in main vehicle deck

11.2.3 Inboard draining scuppers do not require valves but are to be led to suitable drain tanks (not engine room or hold bilges) and the capacity of the tanks ~~should~~ is to be sufficient to hold approximately ~~10~~ 20 minutes of drenching water. The arrangements for emptying these tanks are to be approved and suitable high level alarms provided.

Part 5, Chapter 1

General Requirements for the Design and Construction of Machinery

Effective date 1 July 2015

■ *Section 6*
Quality Assurance Scheme for Machinery

Existing Section 6 has been deleted in its entirety.

6.1 General

6.1.1 The Quality Assurance Scheme for Machinery (QAM Scheme) is an alternative to direct survey and certification of machinery components and equipment required by the Rules. Under the QAM Scheme LR will consider the extent to which manufacturing processes and control procedures ensure conformity of that machinery to Rules, technical specifications and any other applicable standards or codes.

6.1.2 This QAM Scheme is applicable to items manufactured under closely controlled conditions. A list of products for which the QAM Scheme is applicable is provided in LR's ShipRight Procedure *Approval of a Manufacturer according to the Quality Assurance Scheme for Machinery*.

6.1.3 The QAM Scheme does not reduce the test requirements to be carried out in accordance with LR's Rules.

6.2 Definitions

The following definitions apply in the context of this Section:

6.2.1 **QAM Scheme audit**
An audit, conducted by LR at the manufacturer's, or their supplier's or subcontractor's, works, of their products and/or processes, which may include direct survey, in order to provide confidence that products are manufactured, tested and inspected in accordance with LR's Rules. Periodicity of surveillance audits is as agreed in the QAM Scheme Certification Schedule, *see* LR's ShipRight Procedure *Approval of a Manufacturer according to the Quality Assurance Scheme for Machinery*.

6.2.2 **Assessment**
A review, conducted by LR, of evidence gained through a number of sources, such as documentation, submitted by the manufacturer, supplier or subcontractor, and regular QAM Scheme audit reports, in order to verify that products are manufactured, tested and inspected in accordance with the Rules.

6.2.3 **Manufacturer**
A company who contracts to supply components or equipment products to a customer or user and applies for approval under the QAM Scheme.

6.2.4 **Supplier**
A company who contracts to supply materials, components or equipment products to the Manufacturer applying for approval under the QAM Scheme.

6.2.5 **Sub-contractor**
A company who contracts to deliver a service to a supplier or manufacturer under the agreed QAM Scheme arrangements.

6.3 QAM Scheme Arrangements

6.3.1 A manufacturer may apply to be approved under the QAM Scheme where the following requirements are met:
(a) The manufacturer has a quality management system which has been certified as meeting the requirements of ISO 9001, or industry-specific equivalent standard, by a certification body accredited by a member of the International Accreditation Forum and recognised by LR.
(b) The manufacturer has processes in place suitable for the products to be certified under the QAM Scheme.
(c) The manufacturer has a satisfactory and documented history of quality performance in the supply of products for which certification under the QAM Scheme is requested.

6.3.2 The scope and arrangements for survey, identification and certification of products covered by the QAM Scheme are to be agreed with LR and will be detailed in a Scheme Certification Schedule. Survey will be based on a technical audit approach, focussing on product realisation. Direct survey may also be used where it is considered appropriate to do so.

6.3.3 The QAM Scheme procedures given in LR's ShipRight Procedure *Approval of a Manufacturer according to the Quality Assurance Scheme for Machinery* are to be complied with.

6.3.4 Where LR is satisfied that the manufacturer meets all of the requirements of the QAM Scheme, and that it is appropriate for the products being manufactured, LR will issue the manufacturer with a QAM Scheme Certificate which will list products covered.

6.3.5 LR reserves the right to carry out unscheduled audits, with appropriate notice, at the manufacturer's works or their suppliers' and sub-contractors' works.

6.3.6 Once every three years, a full re-certification assessment of QAM Scheme compliance, including an audit of the manufacturer's works, will be conducted by LR.

6.3.7 The manufacturer is to advise LR of changes to the product, processes, suppliers or subcontractors which would affect compliance with the QAM Scheme or LR's Rules. Any deviations from the approved plans or specifications are to be reported to LR and written approval obtained prior to dispatch of the items.

6.3.8 Where it is considered that the manufacturer no longer meets the approval requirements for the QAM Scheme, the QAM Scheme Certificate will be suspended. In these circumstances, the manufacturer will be notified in writing of LR's reasons for suspension of the scheme and the manufacturer will revert to direct survey and issue of LR certificates.

6.3.9 **QAM Scheme product certificates**. Where the manufacturer is approved according to the QAM Scheme, they will be entitled to issue 'QAM Scheme product certificates'. These certificates are to clearly detail the product being certified and are to be validated by an authorised representative of the manufacturer. The certificates are to be countersigned by LR to certify that the Rule requirements for that product are being met.

6.4 Acceptance of purchased materials, components and equipment

6.4.1 The manufacturer is to establish and maintain procedures and controls to ensure compliance with LR's requirements for certification of products from its suppliers. The manufacturer is to ensure that purchased products that are required to be certified in accordance with Chapters 3 to 10 of the Rules for Materials are made at works which have been approved by LR for the type and grade of product being supplied. The manufacturer's system for control of purchased products is to be based on one or a combination of the following alternatives:
(a) Product certification by LR at the supplier's works in accordance with the requirements of the Rules.
(b) Product certification by a supplier separately approved by LR under the QAM Scheme or other LR Quality Scheme covering those products.
(c) Product certification by the manufacturer in accordance with quality processes for control of suppliers of purchased products included within the scope of the manufacturer's QAM Scheme approval. These quality schemes are to ensure compliance with Rule requirements for the purchased products.

6.4.2 **Manufacturers' certificates issued under the QAM Scheme**
Where the manufacturer's system for control of purchased products from suppliers is based on paragraph 6.4.1(c) and Surveyors have confirmed that LR Rules are being satisfied, in lieu of LR Certificates for purchased products, the manufacturer will be permitted to accept 'Manufacturers' certificates issued under the QAM Scheme'. The certificates must bear the QAM Scheme mark and the following statement:
"This certificate is issued under the arrangements authorised by Lloyd's Register (operating entity, e.g. EMEA) in accordance with the requirements of the Quality Assurance Scheme for Machinery and Scheme number, QAM……."

Part 5, Chapter 2

~~Oil~~ Reciprocating Internal Combustion Engines

Effective date 1 July 2015

■ *Scope*

Engines providing power for services essential to the safety of the vessel are to be constructed under survey and in accordance with the requirements of this Chapter (*see also* Pt 1, Ch 2,2.4.1).

The requirements of this Chapter are applicable to ~~oil engines (generally known as diesel engines)~~ reciprocating internal combustion engines operating on liquid, gas or dual fuel for main propulsion and ~~to engines intended for~~ essential auxiliary services (hereinafter referred to as engines). Section 3 is not applicable to auxiliary engines having powers of less than 110 kW.

For the purposes of this Chapter engine type, expressed by the manufacturer/licensor's designation, is defined by:

(a) the bore and stroke;
(b) the method of injection (i.e. direct injection, indirect injection, pilot injection);
(c) the fuel pump and injection system (independent line to fuel oil valve, common rail);
(d) the valve and injection operation (by cams or electronically controlled);
(e) the fuel(s) used (liquid, dual-fuel, gaseous, etc.,);
(f) the working cycle (4-stroke, 2-stroke);
(g) the gas exchange (naturally aspirated, turbocharged, etc.,);
(h) the method of turbocharging (pulsating system, constant pressure system);
(j) the charging air cooling system (with or without intercooler, number of stages);
(k) cylinder arrangement (in-line, vee, etc.,);
(l) the maximum continuous power per cylinder (or maximum continuous brake mean effective pressure) at maximum continuous speed;
(m) the manufacturer and type of governor (and control system if applicable) fitted.

A complete engine includes the control system, turbocharger(s) and all ancillary systems and equipment referred to in this Chapter that are used for operation of the engine for which there are rule requirements; this includes systems allowing the use of different fuel types.

~~The requirements for type testing of engines at the manufacturer's works are also included.~~

■ *Section 1*
Plans and particulars

1.1 Approval process

1.1.1 Approval of an engine type will be granted following:

(a) satisfactory design appraisal
(b) satisfactory type testing (*see* Section 14.1).

NOTE: Approval of the engine type is not to be confused with LR Type Approval; LR Type Approval is explained in Pt 1, Ch 2,5.1.

1.1.2 Each complete engine, as defined in the scope, intended for installation on an LR Classed vessel, is to have an LR Engine Certificate.

1.1.3 For the first engine of a type the approval process and the engine certification process may be performed simultaneously.

1.1.4 To apply for an LR Engine Certificate, the following are to be submitted:

(a) a list of all documents identified in the 'for information' and 'for appraisal' columns of Table 2.1.1 with the relevant drawing numbers and revision status. This list is to cross-reference the approved plans previously submitted in accordance with 1.1.1(a) and identify any plans that have been modified.
(b) where there is a licensor/licensee arrangement the list required by 1.1.4(a) is to cross-reference the drawings submitted by the designer in accordance with 1.1.1(a). This list is to identify all changes where the approved design has been modified by the licensee. Where the licensee proposes design modifications to components, a statement is to be made confirming the licensor's acceptance of the proposed changes. If designer/licensor's acceptance is not confirmed, the engine is to be regarded as a different type and is subject to the complete appraisal and type testing process.
(c) all documents with changes from the approved design are to be submitted for review/appraisal.

In all cases the complete set of endorsed documents and the list referenced in 1.1.4(a), which are to be provided by the manufacturer, will be required by the Surveyor(s) attending the manufacturer's works. Where a licensee/licensor arrangement is in place, this set of documents may be a combination of licensor and licensee documents.

1.1.5 An LR Engine Certificate is issued upon satisfactory completion of engine assembly, with associated component testing (*see* Section 2) and factory acceptance testing (*see* Section 11). An alternative method of engine certification is available to manufacturers approved under the Quality Assurance Scheme for Machinery (QAM). *See* Pt 5, Ch1,6.

1.1.6 For appraisal of emergency diesel-generators and turbochargers additional submissions are required. *See* 1.2.3 and 1.2.4 as applicable.

1.1.7 Where required Materials and Components are to be manufactured, tested and certified at a manufacturer approved by LR in accordance with the *Rules for the Manufacture, Testing and Certification of Materials* (hereinafter referred to as Rules for Materials), *see* Section 2, OK as non-ital.

~~1.1~~ 1.2 ~~Plans~~ Submission requirements

~~*1.1.1* The following plans and particulars as applicable are to be submitted for consideration:~~
- ~~Crankshaft assembly plan (for each crank-throw).~~
- ~~Crankshaft details plan (for each crank-throw).~~
- ~~Thrust shaft or intermediate shaft (if integral with engine).~~
- ~~Output shaft coupling bolts.~~
- ~~Main engine securing arrangements where non-metallic chocks are used.~~
- ~~Type and arrangement of crankcase explosion relief valves.~~
- ~~Arrangement and welding specifications with details of the procedures for fabricated bedplate, thrust bearing bedplate, crankcases, frames and entablatures. Details of materials welding consumables, fit-up conditions fabrication sequence and heat treatments are to be included.~~
- ~~Schematic layouts of the following systems:~~
  - ~~Starting air.~~
  - ~~Oil fuel.~~
  - ~~Lubricating oil.~~
  - ~~Cooling water.~~
  - ~~Control and safety.~~
  - ~~Hydraulic oil (for valve lift).~~
- ~~Shielding of high pressure fuel pipes.~~
- ~~Combustion pressure-displacement relationship.~~
- ~~Crankshaft design data as outlined in Section 3.~~
- ~~High pressure parts for fuel oil injection system with specification of pressures, pipe dimensions and materials.~~
- ~~For new engine types that have not been approved by LR, the proposed type test programme.~~
- ~~The type test report on completion of type testing for a new engine type. For mass produced engines a separate report is to be submitted for each engine requiring approval, *see* 17.2.~~
- ~~Additionally, for mass produced engines:~~
  - ~~(a) For consideration of an engine type to be approved:~~
    - ~~(i) Engine specification, *see* 13.1.4.~~
    - ~~(ii) Manufacturing processes and quality control information, *see* 13.2.3.~~
    - ~~(iii) List of sub-contractors for main parts.~~
    - ~~(iv) Procedures for configuring during commissioning.~~
  - ~~(b) For engines of an approved type to be installed on a ship, a compliance and inspection certificate, *see* 13.4.~~
- ~~For engine control, alarm monitoring and safety systems, the plans and information required by Pt 6, Ch 1,1.2.~~
- ~~For electronically controlled engines, the plans and information required by 1.1.6 and 1.1.7.~~
- ~~Schematic layouts showing details and arrangements of oil mist detection/monitoring and alarm systems.~~
- ~~Diesel generator test results that state the engine maximum load steps which satisfy the quality of power supply requirements specified in Pt 6, Ch 2,1.7.~~
- ~~Planned operating profiles for the vessel at sea and during manoeuvring as agreed with the operators.~~

~~*1.1.2* The following plans are to be submitted for information:~~
- ~~Longitudinal and transverse cross-section.~~
- ~~Cast bedplate, thrust bearing bedplate, crankcase and frames.~~
- ~~Cylinder head assembly.~~
- ~~Cylinder liner.~~
- ~~Piston assembly.~~
- ~~Tie rod.~~
- ~~Connecting rod, piston rod, and crosshead assemblies.~~
- ~~Camshaft drive and camshaft general arrangement.~~
- ~~Shielding and insulation of exhaust pipes.~~
- ~~Details of turbochargers, *see* Section 14.~~
- ~~Operation and service manuals.~~
- ~~Vibration dampers/detuners and moment compensators.~~
- ~~Thrust bearing assembly (if integral with engine and not integrated in the bedplate).~~
- ~~Counterweights, where attached to crank-throw, including fastening.~~
- ~~Main engine holding down arrangement (metal chocks).~~

~~*1.1.3* Material specifications covering the listed components in 1.1.1 and 1.1.2 are to be forwarded together with details of any surface treatments, non-destructive testing and hydraulic tests.~~

~~*1.1.4* Plans and details for dead ship condition starting arrangements are to be submitted for appraisal, *see* 9.1.~~

~~*1.1.5* For engine types built under license it is intended that the above documentation be submitted by the Licensor. Each Licensee is then to submit the following:~~

- ~~A list, based on the above, of all documents required with the relevant drawing numbers and revision status from both Licensor and Licensee.~~
- ~~The associated documents where the Licensee proposes design modifications to components. In such cases a statement is to be made confirming the Licensor's acceptance of the proposed changes.~~

~~In all cases a complete set of endorsed documents will be required by the Surveyor(s) attending the Licensee's works.~~

Table 2.1.1 Plans and particulars to be submitted for appraisal

Document	For information	For appraisal
	(X *indicates reason for submission)*	
Engine particulars (LR Form 2073 with general engine and ancillaries information, Project Guide, Marine Installation Manual) [1]	X	
Material specifications of principal components with information on non-destructive material tests and pressure tests		X
Engine cross-section	X	
Engine longitudinal section Engine frames, welding drawings [2,3]	X	 X
Main engine foundation and holding down and securing arrangements	X (metal chocks)	X (non-metallic chocks)
Bedplate and crankcase of cast design Bedplate and crankcase of welded design, with welding details and welding instructions [2,3] Bedplate/oil sump welding drawings [2]	X	 X X
Thrust bearing assembly [4] Thrust shaft or intermediate shaft (if integral with engine) Thrust bearing bedplate of welded design, with welding details and welding instructions [2]	X	 X X
Frame [3], framebox [3] and gearcase of cast construction	X	
Tie rod	X	
Connecting rod, assembly [5]	X	
Crosshead, assembly [5]	X	
Piston rod, assembly [5] Piston, assembly [5] Piston head	X X X	
Cylinder jacket/ block of cast construction [3]	X	
Cylinder cover, assembly [5]	X	
Cylinder liner	X	
Counterweights (if not integral with crankshaft), including fastening	X	
Crankshaft, details (for each crankthrow) Crankshaft, assembly (for each crankthrow) Crankshaft calculations (*see* Section 3)	 X	X X
Camshaft drive, assembly [5]	X	
Flywheel or turning-wheel	X	
Shaft coupling interface arrangement including dimensions and material details		X
Details of shielding and insulation of exhaust pipes and other parts operating at an elevated temperature, which might be impinged by flammable fluid(s) as a result of a system failure	X	
Schematic layout or other equivalent documents for the engine: [6] • Starting and control air systems • Fuel system • Lubricating oil system • Cooling water system • Hydraulic systems • Engine control and safety system		 X X X X X X
High pressure fuel injection pump assembly High pressure parts for fuel oil injection system [7] Shielding arrangements for high pressure piping - fuel, hydraulic & flammable oils (*see* 8.1.4)	X	 X X
Fastening arrangements for main bearings Fastening arrangements for cylinder heads and exhaust valve (two stroke design)	X X	

Fastening arrangements for connecting rods	X	
Vibration dampers/detuners and moment compensators Construction and arrangement of vibration dampers	X X	
Details of mechanical joints of piping systems		X
Oil mist detection and/or alternative arrangements		X
Construction of accumulators (common rail) for electronically controlled engine Construction of common accumulators (common rail) for electronically controlled engine Construction of accumulators for hydraulic oil and fuel oil		X X X
Arrangement and details of the crankcase explosion relief valve where applicable (*see* Section 10) Calculation results for crankcase explosion relief valves (*see* Section 10)		X X
Construction and arrangements of hydraulic systems for actuation of sub-systems: • Control valves, high-pressure pumps, pipes and accumulators • Drive for high pressure pumps • Valve bodies, if applicable	 X X X	
For engine control, alarm monitoring and safety systems, the plans and information required by 1.2.2 [8] Diesel generator test results that state the engine maximum load steps which satisfy the quality of power supply requirements specified in Pt 6, Ch 2, 1.7 Planned operating profiles for the vessel at sea and during manoeuvring as agreed with the Operators List of sub-contractors for main parts	 X	X X X
Operation and service manuals [9]	X	
Risk-based analysis (for engine control system) [10] Test program resulting from risk-based analysis (for engine control system) [10]	X X	
Production specifications for castings and welding procedures	X	
Evidence of quality control system for engine design, production and in-service maintenance [5, 11]	X	
Type approval certification for environmental tests of control components [12] Details of the engine type test program and the type test report [13] Engine test schedule (FAT & shipboard trials, *see* 1.2.1)	X	 X X
Documentation verifying compliance with inclination limits (*see* Ch 1,3.7)		X
Combustion pressure-displacement relationship		X
Plans and details for dead ship condition starting arrangements, *see* 9.1		X

NOTES:

1. LR Form 2073 will be supplied on application. Note that the turbochargers, if required to be type approved, are to have plans and particulars submitted as detailed in 1.2.4.
2. For approval of materials and weld procedure specifications. The weld procedure specification is to include details of pre- and post-weld heat treatment, weld consumables and fit-up conditions.
3. For each cylinder for which dimensions and details differ.
4. If integral with engine and not integrated in the bedplate.
5. Including identification of components to ensure traceability in accordance with the Rules for Materials.
6. Details of the system so far as supplied by the engine manufacturer such as: main dimensions, operating media and maximum working pressures.
7. The documentation to contain specifications for pressures, pipe dimensions and materials.
8. The submission is to include a general overview of the operating principles, supported by schematics explaining the functionality of individual systems and sub-systems. The information is to relate to the engine capability and functionality under defined operating and emergency conditions such as recovery from a failure or malfunction, with particular reference to the functioning of programmable electronic systems and any sub-systems. The information is also to indicate if the engine has different modes of operation, such as to limit exhaust gas emissions and/or to run under an economic fuel consumption mode or any other mode that is electronically controlled.
9. Operational manuals are to contain maintenance requirements (servicing and repair) including details of any special tools and gauges that are to be used with their fitting/settings together with any test requirements on completion of maintenance. They are to include a description of each system's particulars and include reference to the functioning of sub-systems.
10. Where engines rely on hydraulic, pneumatic or electronic control of fuel injection and/or valves, the risk-based analysis is to address the mechanical, pressure containing, electrical, electronic and programmable electronic systems and arrangements that support the operation of the engine. It is to demonstrate that failure of the control system will not result in the operation of the engine being degraded beyond acceptable performance criteria for the engine and that suitable risk mitigation has been achieved in accordance with 4.2. The risk-based analysis will not be explicitly approved by LR.
11. Including quality plan for sourcing, traceability, design, installation and testing of all components used in the fuel and hydraulic oil systems installed with the engine.
12. Tests are to demonstrate the ability of the control, protection and safety equipment to function as intended under the specified testing conditions as per Lloyd's Register Type Approval Test Specification Number 1.
13. The type test report may be submitted shortly after the conclusion of the type test. For electronically controlled engines evidence of type testing of the engine with the programmable electronic system, or a proposed factory acceptance test plan at the engine builders with the programmable electronic system functioning, is to be submitted to verify the functionality and behaviour under normal operating and fault conditions of the programmable electronic control system.

~~*1.1.6* Where engines incorporate electronic control systems the following additional information is to be submitted:~~

~~(a) A general overview of the operating principles, supported by schematics explaining the functionality of individual systems and sub-systems. The information is to relate to the engine capability and functionality under defined operating and emergency conditions such as recovery from a failure or malfunction, with particular reference to the functioning of programmable electronic systems and any sub-systems. The information is also to indicate if the engine has different modes of operation, such as to limit exhaust gas emissions and/or to run under an economic fuel consumption mode or any other mode that is electronically controlled.~~

~~(b) Operating manuals which describe the particulars of each system and, together with maintenance instructions, include reference to the functioning of sub-systems.~~

~~(c) A risk-based analysis of the mechanical, pressure containing, electrical, electronic and programmable electronic systems and arrangements that support the operation of the engine. The analysis is to demonstrate that suitable risk mitigation has been achieved in accordance with 4.2.~~

~~(d) Details of hydraulic systems for actuation of subsystems (fuel injection or exhaust), to include details of the design/construction of pipes, pumps, valves, accumulators and the control of valves/pumps. Details of pump drive arrangements are also to be included.~~

~~(e) Quality plan for sourcing, design, installation and testing of all components used in the oil fuel and hydraulic oil systems installed with the engine for engine operation.~~

~~(f) Fatigue analysis for all high pressure oil fuel and hydraulic oil piping arrangements required for engine operation where failure of the pipe or its connection or a component would be the cause of engine unavailability. The analysis is to concentrate on high pressure components and sub-systems and recognise the pressures and fluctuating stresses that the pipe system may be subject to in normal service.~~

~~(g) Evidence of type testing of the engine with the programmable electronic system, or a proposed test plan at the engine builders with the programmable electronic system functioning, to verify the functionality and behaviour under normal operating and fault conditions of the programmable electronic control system.~~

~~(h)~~ *1.2.1* ~~Schedule~~ A schedule of testing at engine builders, pre-sea trial commissioning and sea trials is to be submitted. The test schedules are to identify all modes of engine operation and the sea trials are to include typical port manoeuvres under the intended engine operating modes. The schedule is to include:

(~~i~~a) testing and trials to demonstrate that the engine is capable of operating as described in ~~(a)~~ Table 2.1.1, Note 8;

(~~ii~~b) tests to verify that the response of the complete mechanical, hydraulic, electrical and electronic system is as predicted for the intended operational modes; and

(~~iii~~c) testing required to verify the conclusions of the risk-based analysis.

The scope of these tests is to be agreed with LR based on the risk-based analysis.

~~*1.1.7*~~ *1.2.2* In addition to the applicable plans and particulars required by Pt 6, Ch 1,~~1.2~~1.2~~.3 to 1.2.6~~ the following information for control, alarm, monitoring and safety systems relating to the operation of an electronically controlled engine is to be submitted:

(a) Engine configuration details, *see* 4.3.2.
   (i) Local and remote means to carry out system configuration.
   (ii) Engine builder procedures for undertaking configuring.
   (iii) Roles and responsibilities for configuration (e.g. Engine builder, engine packager, system integrator or other nominated party) with accompanying schedule.
   (iv) Configurable settings and parameters (including those not to be modified from a default value).
   (v) Configuration for propulsion, auxiliary or emergency engine application.

   Configuration records are to be maintained and are to be made available to the Surveyor at testing and trials and on request in accordance with Pt 6, Ch 1,1.4 and 7.1.3.
(b) Software quality plans, including configuration management documents.
(c) Software safety evidence.
(d) Software assessment inspection report.

Existing paragraph 1.1.8 *has been renumbered* 1.2.3*.*

~~*1.1.9* The following plans and particulars are to be submitted for information:~~

~~• Cross sectional plans of the assembled turbocharger with main dimensions.~~
~~• Fully dimensioned plans of the rotor.~~
~~• Material particulars with details of welding and surface treatments.~~
~~• Turbo-charger operating and test data.~~
~~• A selected turbocharger is to be type tested.~~
~~• Manufacturer's burst test assessment.~~

1.2.4 For turbochargers, the following plans and particulars are to be submitted for information:

(a) Cross-sectional drawing with principal dimensions and materials of housing components for containment evaluation.
(b) Drawings of the housing and rotating parts including details of blade fixing.
(c) Material specifications (chemical composition and mechanical properties) of all parts mentioned in (b) above including details of the material and quality control system to be used for these parts.
(d) Welding details and welding procedure of above mentioned parts, if applicable.
(e) Documentation of containment in the event of disc fracture, *see* 12.5.
(f) Type test reports
(g) Operational data and limitations, i.e.:
   • Maximum permissible operating speed (rpm)
   • Alarm level for over-speed
   • Maximum permissible exhaust gas temperature before turbine

- Alarm level for exhaust gas temperature before turbine
- Minimum lubrication oil inlet pressure
- Lubrication oil inlet pressure low alarm set point
- Maximum lubrication oil outlet temperature
- Lubrication oil outlet temperature high alarm set point
- Maximum permissible vibration levels, i.e. self- and externally generated vibration
  (Alarm levels may be equal to permissible limits but are not to be reached when operating the engine at 110 per cent power or at any approved intermittent overload beyond 110 per cent.)

(h) Arrangement of lubrication system, all variants within a range.
(j) A list of main current suppliers and subcontractors for rotating parts and an operation and maintenance manual.
(k) Documentation* of safe torque transmission when the disc is connected to the shaft by an interference fit, *see* 12.6.
(l) Information on expected lifespan, considering creep, low cycle fatigue and high cycle fatigue.
(m) Operation and maintenance manuals*.
NOTE: * Applicable to two sizes in a generic range of turbochargers.

Existing paragraph 1.1.10 *has been renumbered* 1.2.5*.*

1.2.6 The following information is to be submitted to LR for acceptance of oil mist detection equipment and alarm arrangements:
(a) Description of oil mist detection equipment and system including alarms.
(b) Copy of the test house report in accordance with the requirements of Test Specification No. 4. *See also* 14.4.
(c) Schematic layout of engine oil mist detection arrangements showing location of detectors/sensors and piping arrangements and dimensions.
(d) Maintenance and test manual which is to include the following information:
  (i) Intended use of equipment and its operation;
  (ii) Functionality tests to demonstrate that the equipment is operational and that any faults can be identified and corrective actions notified;
  (iii) Maintenance routines and spare parts recommendations;
  (iv) Limit setting and instructions for safe limit levels; and
  (v) Where necessary, details of configurations in which the equipment is and is not to be used.

■ *Section 2*
Materials and Components

2.2 Material test and inspections

2.2.1 Materials and ~~C~~components for engines are to be manufactured tested and certified as indicated in Table 2.2.1 and in accordance with the relevant requirements of the ~~*Rules for the Manufacture, Testing and Certification of Materials* (hereinafter referred to as the~~ Rules for Materials~~)~~.

Table 2.2.1 Test and certification requirements for ~~oil~~ engine components

Component	Material tests	Non-destructive tests: Magnetic particle or Liquid penetrant	Non-destructive tests: Ultrasonic
Crankshaft	all	all	all
Crankshaft coupling flange (non-integral) for main propulsion engines	above 400 mm bore	—	—
Crankshaft coupling bolts	above 400 mm bore	—	—
Steel piston crowns	above 400 mm bore	above 400 mm bore	all
Piston rods	above 400 mm bore	above 400 mm bore	above 400 mm bore
Connecting rods, including bearing caps	all	all	above 400 mm bore
Crosshead	above 400 mm bore	—	—
Cylinder liner	above 300 mm bore	—	—
Cylinder cover	above 300 mm bore	above 400 mm bore	all
Steel castings for welded bedplates	all	all	all
Steel forgings for welded bedplates	all	—	—
Plates for welded bedplates, frames and entablatures	all	—	—
Crankcases, welded or cast	all	—	—

Tie rods	all	above 400 mm bore	—
Turbo-charger, shaft and rotor	above 300 mm bore	—	—
Bolts and studs for cylinder covers, crossheads, main bearings, connecting rod bearings	above 300 mm bore	above 400 mm bore	—
Steel gear wheels for camshaft drives	above 400 mm bore	above 400 mm bore	—

NOTES
1. For closed-die forged crankshafts the ultrasonic examination may be confined to the initial production and to subsequent occasional checks.
2. Magnetic particle or liquid penetrant testing of tie rods may be confined to the threaded portions and the adjacent material over a length equal to that of the thread.
3. Cylinder covers and liners manufactured from spheroidal or nodular graphite iron castings may not be suitable for ultrasonic NDE, depending upon the grain size and geometry. An alternative NDE procedure is to be agreed with LR.
4. Bore dimensions refer to engine cylinder bores.
5. All required material tests are to be witnessed by the Surveyor unless alternative arrangements have been specifically agreed by LR.
6. For mass produced engines, *see* Section 13.

Part	Materials Tests				Component Tests		LR Component Certification
	Material Properties (1)	Surface Inspection (2)	Ultrasonic Inspection	LR Material Certification (3)	Hydraulic testing (5) (All Engines)	Visual inspection (All Engines)	
Steel castings for welded bedplates	All	All	All	a	-	fit-up + post-welding	X
Steel forgings for welded bedplates	All	-	-	a	-	fit-up + post-welding	X
Plates for welded bedplates, frames and entablatures	All	-	-	a (4)	-	fit-up + post-welding	X
Bearing transverse girders	All	All	All	a	-	V	X
Crankcases, welded or cast	All	-	-	a (4)	-	V	X
Welded frame box	All	All	All	b (4)	-	fit-up + post-welding	X
Engine block	>400kW/cylinder	-	-	a	1,5p	V	X
Cylinder block	All	-	-	a	1,5p	V	X
Welded cylinder frames	All	All	All	a (4)	-	fit-up + post-welding	X
Tie rod	All	Bore>400mm (6)	-	b	-		-
Bolts and studs for cylinder covers, crossheads, main bearings, tie rods and connecting rod bearings	Bore >300mm	Bore>400mm	Bore >400mm	c	-	V	-
Cylinder liner	Bore >300mm	All	All	a	7,0 bar	-	X
Cylinder cover	Bore >300mm	Bore>400mm	All (5)	a	7,0 bar (7)	V	X
Turbocharger, shaft & rotor	Bore >300mm	-	-	c	-	V	X
Turbocharger casing	(11)	(11)	(11)	c	G (8)	V	X
Crankshaft	All	All	All	a	-	V+D	X
Crankshaft coupling flange (non-integral)	Main propulsion bore>400mm	-	-	a	-	V+D	X
Semi-built crankshaft (Crankthrow, forged main journal and journals with flange)	All	All	All	a		V+D	X
Connecting rod assembly	M	All +CD	Bore >400mm	a	-	V+D	X

Crankshaft coupling bolts	Bore >400mm	Bore >400mm	Bore >400mm	c	-	V+D	X
Crosshead	Bore >400mm	Bore >400mm	Bore >400mm	a	-	V	X
Piston rod, if applicable	Bore >400mm	Bore >400mm	Bore >400mm	a	-	V	X
Piston crown (steel)	Bore >400mm	Bore >400mm	All	a	7,0 bar (7)	V	X
Steel gear wheels for camshaft drives	Bore >400mm	Bore >400mm	-	b	-	-	-
High pressure fuel injection system - valve, pipe, pump body (pressure side) (10)	All	-	-	a	Lesser of 1,5p or p+300 bar (9)	V	X
Coolers, both sides (12)	-	-	-	-	G	V	(13)
Accumulator of common rail fuel or servo oil system	Accumulators with a capacity >0,5 l	-	-	-	1,5p		X
Bearings for main, crosshead, and crankpin (14)	>800kW/cylinder	-	>800kW/cylinder	c	-	V+D	-
Piping, pumps, actuators, etc., for hydraulic systems, if applicable	All	-	All (Welds)	(15)	1,5p	V	(13)
Engine driven pumps - oil, water, fuel, bilge	-	-	-	(15)	G	-	X
Cylinder jacket cooling space (16)	-	-	-	-	G	-	-
Exhaust pipe cooling space	-	-	-	-	G	-	-
Exhaust valve cooling space	-	-	-	-	G	-	-
Air compressor inc. cylinders, covers, intercoolers & after coolers (12)	Calculated crankpin ≥50mm	-	-	c	Air side: 1,5p Water side: G	-	X

SYMBOLS:

Bore dimensions refer to engine cylinder bores

p = Max. working pressure of item concerned

G = Pressure test at greater of -4,0 bar or -1,5p

V = Visual examination of accessible surfaces by Surveyor (11)

D = Dimensional inspection, including surface condition

X = LR Component Certification required

NOTES:

1. Material properties include chemical composition and mechanical properties, and also surface treatment such as surface hardening (hardness, depth and extent), peening and rolling (extent and applied force). All required material tests are to be carried out in accordance with the relevant Chapters of the Rules for Materials.
2. Magnetic particle testing is to be carried out on Ferro-magnetic materials, liquid penetrant testing is only to be carried out on non-ferritic materials. Visual examination alone is not considered sufficient
3. The certificate type required refers to the Rules for Materials Chapter 1 Section 3.1.3.
4. Where welding is carried out, welding procedures and welder qualifications are to be carried out in accordance with the Rules for Materials Chapter 12.
5. Hydraulic testing is applied on the water/oil side of the component. The full lengths of cooling spaces are to be tested where applicable. Tests are to be witnessed by the Surveyor and an LR Test Certificate will be issued.
6. Magnetic particle testing of tie rods may be confined to the threaded portions and the adjacent material over a length equal to that of the thread.
7. For forged steel cylinder covers and piston crowns alternative testing methods may be specially considered. Where the piston rod seals the piston crown cooling space, it is to be tested after assembly.
8. Hydraulic testing of the cooling space. Turbocharger air coolers need only be tested on the water side.
9. Where components are subjected to an autofrettage process approved by LR, the component pressure test may be omitted. The assembled system containing such components is to be shown, where practicable, to be pressure-tight as required for hydraulic systems.
10. Pumps used in jerk or times pump systems need only have the assembled high pressure containing components hydraulically tested.
11. Dependent upon specific application.
12. Material and component certification for accumulators or coolers which are classed as pressure vessels are dependent on the operating pressure and temperature *see* Ch 11,1.5 & 1.7.
13. LR component certification required where the component is necessary for the operation of main propulsion or auxiliary engines which are the source of power for services essential for safety or for the operation of the ship at sea.
14. Ultrasonic testing required to prove full contact between basic material and bearing metal; only chemical properties required for

materials testing.
15. Material certification requirements for pumps and piping components are dependent on the operating pressure and temperature, *see* Ch 12,1.5 & 1.6.
16. Where it is more practical to test the assembled engine (i.e. for engines with a multiple cylinder engine block), a leak test at working pressure may be accepted.

2.2.2 For components of novel design special consideration will be given to the acceptability of material ~~test~~ properties and non-destructive testing requirements. For components and materials not specified in Table 2.2.1, consideration will be given by LR upon submission and review of their full details.

2.2.3 With reference to Table 2.2.1, certification is to be in accordance with Rules for Materials, Ch 1,3.1 and of the type as specified in Table 2.2.1.

2.2.4 The certificate is to be in accordance with the Rules for Materials Chapter 1 Section 3.1.3(d) where the manufacturer or material supplier operates an approved LR Quality Scheme.

2.2.5 The manufacturer is not exempted from responsibility for any relevant tests and inspections of those parts for which documentation is not explicitly requested by LR.

~~12.1~~ 2.3 Hydraulic tests

~~12.1.1~~ 2.3.1 In general, items are to be tested by hydraulic pressure as indicated in Table ~~2.12.1~~ 2.2.1. Where design features are such that modifications to the test requirements shown in Table ~~2.12.1~~ 2.2.1 are necessary, alternative proposals for hydraulic tests are to be submitted for special consideration.

~~Table 2.12.1 Test pressures for oil engine components~~

Item	Test pressure
Fuel injection system: Pump body, pressure side; Valve; Pipe	The lesser of 1,5*p* or *p* + 300 bar
Cylinder cover, cooling space Cylinder liner, over the whole length of cooling space Piston crown, cooling space (where piston rod seals cooling space, test after assembly)	7,0 bar
Cylinder jacket, cooling space Exhaust valve, cooling space Turbo-charger, cooling space Exhaust pipe, cooling space Coolers, each side Engine driven pumps (oil, water, fuel, bilge)	The greater of 4,0 bar or 1,5*p*
Air compressor, including cylinders, covers, intercoolers and aftercoolers	Air side: 1,5*p* Water side: The greater of 4,0 bar or 1,5*p*
Scavenge pump cylinder	4,0 bar
Hydraulic systems (piping, pumps, actuators)	1,5*p*

NOTES
1. *p* is the maximum working pressure in the item concerned.
2. Pumps used in jerk or timed pump systems need only have the assembled high pressure-containing components hydraulically tested.
3. Turbo-charger air coolers need only be tested on the water side.
4. For forged steel cylinder covers and piston crowns alternative testing methods may be specially considered.
5. For hydraulic systems where design features are such that modifications to the test requirements are necessary, alternative proposals for hydraulic tests are to be submitted for special consideration.
6. Where components are subjected to an autofrettage process approved by LR, the component test pressure may be omitted. The assembled system containing such components is to be shown, where practicable, to be pressure-tight as required for Hydraulic systems.

~~12.1.2~~ 2.3.2 Where a manufacturer has demonstrated to LR that they have an acceptable quality management system, a manufacturer's hydraulic test certificate may be accepted for engine driven pumps as detailed in Table ~~2.12.1~~ 2.2.1. Recognition and acceptance of the works quality control processes can be by one of the following routes:

(a) Approval under the ~~LR Quality Scheme for Machinery~~ Quality Assurance Scheme for Machinery (QAM).

(b) Approval of an alternative quality scheme recognised by LR.

~~(c) Approval by LR through auditing of the manufacturer's quality system.~~

~~12.2~~ 2.4 Alignment gauges

Existing paragraph 12.2.1 *has been renumbered* 2.4.1*.*

~~12.3~~ 2.5 ~~Auto frottage~~ Autofrettage

~~*12.3.1* Manufacturers who carry out auto-frettage to enhance the fatigue life of components are to be approved by LR.~~

~~*12.3.2* LR certificates are to be issued for components subject to autofrettage, provided the attending Surveyors are satisfied that the accepted QA process has been applied.~~

2.5.1 Manufacturers who carry out autofrettage to enhance the fatigue life of components are to be approved by LR.

2.5.2 LR certificates are to be issued provided the attending Surveyors are satisfied that the required process parameters and associated QA processes have been applied.

■ *Section 3* **Design**

3.1 Scope

3.1.5 Section 3 is not applicable to auxiliary engines having powers of less than 110 kW.

3.7 Equivalent alternating stress

3.7.2 Equivalent alternating stress for the outlet of the crankpin oil bore σ_{eob}, is defined as:

$$\sigma_{eob} = \pm \frac{1}{3}\sigma_{bo}\left[1+2\sqrt{1+\frac{9}{4}\frac{\tau_{to}^{2}}{\sigma_{bo}}}\right] \quad N/mm^2$$

$$\sigma_{eob} = \pm \frac{1}{3}\sigma_{bo}\left[1+2\sqrt{1+\frac{9}{4}\left(\frac{\tau_{to}}{\sigma_{bo}}\right)^{2}}\right] \quad N/mm^2$$

■ *Section 4* **Electronically controlled engines**

4.1 General

4.1.2 These engines may be of the ~~slow, medium or highspeed type~~ crosshead or trunk piston type. They generally have no direct camshaft driven fuel systems, but have common rail fuel/hydraulic arrangements and may have hydraulic actuating systems for the functioning of the exhaust systems.

4.3 Control engineering systems

4.3.2 The engine control, alarm monitoring and safety systems are to be configured to comply with the relevant requirements (e.g.~~,~~ operating profile, alarms, shutdowns, etc.) of this Chapter and Pt 6, Ch 1 for an engine for main, auxiliary or emergency power purposes. Details of the engine configuration are to be submitted for consideration ~~identifying:~~, *see* 1.2.2(a).

~~(a) Local and remote means to carry out system configuration.~~
~~(b) Enginebuilder procedures for undertaking configuring.~~
~~(c) Roles and responsibilities for configuration (e.g., Enginebuilder, engine packager, system integrator or other nominated party) with accompanying schedule.~~
~~(d) Configurable settings and parameters (including those not to be modified from a default value).~~
~~(e) Configuration for propulsion, auxiliary or emergency engine application.~~

~~Configuration records are to be maintained and are to be made available to the Surveyor at testing and trials and on request in accordance with Pt 6, Ch 1,1.4 and 7.1.3.~~

4.4 Software

4.4.3 To demonstrate compliance with 4.4.1 and 4.4.2:

(a) software quality plans and safety evidence are to be submitted for consideration, *see* ~~4.2.2(b) and (c)~~ 1.2.2(b); and

(b) an assessment inspection of the Enginebuilder's completed development is to be carried out by LR. The inspection is to be tailored to verify application of the standards and codes used in software safety assurance accepted by LR.

■ *Section 7*
Control and monitoring of main, auxiliary and emergency ~~diesel~~ engines

7.1 General

(*Part only shown*)

7.1.2 Oil mist detection, or engine bearing temperature monitors or alternative methods for crankcase protection are to be provided:

NOTES

1. For ~~medium and high speed~~ trunk piston engines, automatic shutdown of the engine is to occur.
2. For ~~slow speed~~ crosshead engines, automatic slow-down is to occur.

7.6 ~~Oil e~~Engines for propulsion purposes

(*Part only shown*)

Table 2.7.1(a) ~~Oil engines~~ Engines for propulsion purposes: Alarms and slow-downs

Item	Alarm	Note
~~Oil mist concentration in crankcase or bearing temperature~~	~~High~~	~~Automatic slow-down of slow speed engines, *see* 7.1.2. One sensor per lubricator unit. Slow-down (automatic on medium and high speed engines)~~
~~Cylinder lubricator flow~~	~~Low~~	
Oil mist concentration in crankcase or bearing temperature	High	*See* 7.1.2. Automatic slow-down of crosshead engines, for trunk piston engines *see* Table 2.7.1(b)
Cylinder lubricator flow	Low	One sensor per lubricator unit on crosshead engines. Slow down.
Cylinder coolant inlet pressure or flow*	Low	Slow-down (automatic on ~~medium and high speed~~ trunk piston engines)
Cylinder coolant outlet temperature*	1st stage high	Per cylinder (if a separate system). Slow-down (automatic on ~~medium and high speed~~ trunk piston engines)
Charge air cooler outlet temperature	High ~~and Low~~	~~4-stoke medium and high speed~~ Trunk piston engines
Exhaust gas temperature*	High	Per cylinder. Slow-down (automatic on ~~medium and high speed~~ trunk piston engines), *see* Note 5
~~Turbo-charger~~ Turbocharger exhaust gas inlet temperature	High	Each ~~turbo-charger *See*~~ turbocharger, *see* Note 6
~~Turbo-charger~~ Turbocharger exhaust gas outlet temperature*	High	Each ~~turbo-charger~~ turbocharger
~~Turbo-charger~~ Turbocharger lubricating oil inlet pressure	Low	~~If system not integral with turbo-charger~~ *See* Note 10
~~Turbo-charger~~ Turbocharger lubricating oil outlet temperature	High	Each bearing, if system not integral with ~~turbo-charger~~ turbocharger. *See* Note 7 and 10

NOTES

1. Where 'per cylinder' appears in this Table, suitable sensors may be situated on manifold outlets for ~~medium and high speed engines~~ trunk piston engines.
5. For ~~medium and high speed~~ trunk piston engine power <500 kW/cylinder, a common sensor for exhaust gas manifold temperature may be fitted.
6. ~~May be combined with exhaust gas outlet temperature high alarm where the turbo-charger is mounted directly on the exhaust manifold~~ Alarm and indication of the exhaust gas temperature at turbocharger inlet may be waived if alarm and indication for individual exhaust gas temperature is provided for each cylinder and the alarm level is set to a value specified by the turbocharger manufacturer.
10. Separate sensors are to be provided if the lubrication oil system of the turbocharger is not integrated with the lubrication oil system of the engine or if it is separated by a throttle or pressure reduction valve from the engine lubrication oil system. Where the turbocharger is provided with a self-contained lubricating oil system integrated with the turbocharger, lubricating oil inlet pressure need not be monitored.

Table 2.7.1(b) ~~Oil engines~~ Engines for propulsion purposes: ~~Alarms and slow-downs~~ Automatic shutdowns

Item	Alarm	Note
Lubricating oil inlet pressure	2nd stage low	Automatic ~~shut-down~~ shutdown of engines, *see* 7.5.4
Oil mist concentration in crankcase or bearing temperature	High	*See* 7.1.2. Automatic ~~shut-down~~ shutdown of ~~medium and high speed~~ trunk piston engines, ~~*see* 7.1.2~~ for crosshead engines *see* Table 2.7.1(a)
Cylinder coolant outlet temperature	2nd stage high	Automatic ~~shut-down~~ shutdown of ~~medium and high speed~~ trunk piston engines, *see* 7.5.4
Overspeed	High	Automatic ~~shut-down~~ shutdown of engine, *see also* 7.4. Details of alternative proposals in accordance with the manufacturerer's instructions may be submitted for consideration

7.7 Auxiliary engines

(*Part only shown*)

Table 2.7.2 Auxiliary engines: Alarms and safeguards

Item	Alarm	Note
Uptake temperature	High	To monitor for soot fires. *See* Notes 3 and 4
Turbocharger lubricating oil outlet temperature	High	Each bearing, *see* Note 5
Turbocharger lubrication oil inlet pressure	Low	*See* Note 6
NOTES		
5. Unless provided with a self-contained lubricating oil system integrated with the turbocharger.		
6. Where outlet temperature from each bearing cannot be monitored due to the engine/turbocharger design alternative arrangements may be accepted. Continuous monitoring of inlet pressure and inlet temperature in combination with specific intervals for bearing inspection in accordance with the turbocharger manufacturer's instructions may be accepted as an alternative.		

7.8 Emergency ~~diesel~~ engines

(*Part only shown*)

Table 2.7.3 Emergency ~~diesel~~ engines: Alarms and safeguards

Item	Alarm for engine power <220 kW	Alarm for engine power ~~≤~~≥220kW	Note

■ *Section 8* Piping

8.1 ~~Oil fuel~~ Fuel oil, hydraulic and high pressure oil systems

~~*8.1.4* All external high-pressure fuel delivery lines between the high-pressure fuel pumps and fuel injectors are to be protected with a jacketed piping system capable of containing fuel from a high-pressure line failure. If flexible hoses are used for shielding purposes, these arrangements are to be approved.~~

8.1.4 All external high pressure fuel system piping between the high pressure fuel pumps and fuel injectors are to be protected with a jacketed piping system capable of containing leakage and/or spray of flammable fluid from a high-pressure pipe failure. The arrangements are to be approved, *see* Table 2.1.1.

■ *Section 10*
Safety arrangements

10.1 Relief valves

10.1.4 Each valve is to be fitted with a flame arrester that permits flow for crankcase pressure relief and prevents the passage of flame following a crankcase explosion. The valves are to be type tested in a configuration that represents the installation arrangements that will be used on an engine and in accordance with ~~Section 18~~ Section 14.3. The valves are to be positioned on engines to minimise the possibility of danger and damage arising from emission of the crankcase atmosphere. Where shielding from the emissions is fitted to a valve, the valve is to be type tested to demonstrate that the shielding does not adversely affect the operational effectiveness of the valve.

10.2 Number of relief valves

10.2.1 ~~In engines having cylinders not exceeding 200 mm bore or having a crankcase gross volume not exceeding 0,6 m^3, relief valves may be omitted.~~ Internal combustion engines having a cylinder bore of 200 mm and above or a crankcase volume of 0,6 m^3 and above shall be provided with crankcase explosion relief valves.

10.8 Oil mist detection

10.8.1 Where crankcase oil mist detection arrangements are fitted, they are to be of a type approved by LR, tested in accordance with ~~Section 19~~ Section 14.4 and comply with 10.8.2 to 10.8.15.

■ *Section 11*
~~Program for trials of diesel engines to assess operational capability~~ Factory Acceptance Test and Shipboard Trials of Internal Combustion Engines

11.1 Safety

11.1.1 Before any test is carried out, all safety functions are to be operational to ensure the safety of the attending personnel is to be made available by the manufacturer / shipyard and is to be operational. This is to include crankcase explosive conditions protection, overspeed protection and any other shutdown function.

11.1.2 The overspeed protective device is to be set to a value which is not higher than the overspeed value that was demonstrated during the type test for that engine. This set point is to be verified by the Surveyor.

11.2 General

~~*11.1.1*~~ *11.2.1* ~~Diesel e~~Engines which are to be subjected to trials on the test bed at the manufacturer's works and under attendance by the Surveyor(s) are to be tested in accordance with the scope of works trials specified in ~~11.1.2 to 11.1.10~~ 11.3. The scope of the trials is to be agreed between the LR Surveyor and the manufacturer prior to testing. At the discretion of the Surveyor, the scope of the trials may be extended depending on the engine application.

11.2.2 Where multiple engines of the same design are manufactured, a quality assurance approach to approval may be applied if the manufacturer meets the requirements of and is registered on the Quality Assurance Scheme for Machinery (QAM). (*See* Chapter 1, Section 6).

11.2.3 Before any official testing the engines are to be run in as prescribed by the engine manufacturer.

11.2.4 Adequate test bed facilities for loads as required in Table 2.11.1 are to be provided. All fluids used for testing purposes such as fuel, lubrication oil and cooling water are to be suitable for the purpose intended, e.g. they are to be clean, pre-heated, if necessary, and cause no harm to engine parts. This applies to all fluids used temporarily or repeatedly for testing purposes only.

11.2.5 Survey of the engine is to include:

(a) Jacketing of high-pressure fuel oil lines including the system used for the detection of leakage.
(b) Screening of pipe connections in piping containing flammable liquids.
(c) Insulation of hot surfaces by taking random temperature readings that are to be compared with corresponding readings obtained during the type test. This is to be done while running at the maximum approved rating for the actual application. Use of contact thermometers may be accepted at the discretion of the attending Surveyor. If the insulation is modified subsequently to the Type Approval Test, LR may request more enhanced temperature measurements as required by the LR's Type Approval Test Specification No. 4, Section 10.2.7 (Fire Protection Measures).

These surveys are normally to be made during the works trials by the manufacturer and the attending Surveyor, but at the discretion of LR parts of these surveys may be postponed to the shipboard testing.

11.2.6 Where the type test was not carried out on the complete engine, as described in 1.1.2, integration tests are to be conducted as part of the works or shipboard trials to confirm satisfactory operation of the complete engine. This includes satisfactory functioning on all fuel types on which the engine is to operate. *See also* 11.4.7.

~~11.1~~ 11.3 Works trials (factory acceptance test)

11.3.1 The purpose of the works trials is to verify design parameters such as power, adherence to approved limits (e.g. maximum pressure) and functionality, and to establish reference values or base lines for later reference in the operational phase.

11.3.2 For each load point the parameters to be recorded include: Power and speed; Fuel index (or equivalent reading); Maximum combustion pressures; Exhaust gas temperature before turbine and from each cylinder (or from manifold, *see* note 5 in table 2.7.1(a)); Charge air temperature and pressure.

~~*11.1.3*~~ *11.3.3* For all stages of the works trials the pertaining operation values are to be measured and recorded by the engine manufacturer. All results are to be compiled in an acceptance protocol to be issued by the engine manufacturer. The crankshaft deflection is to be checked when this check is required by the manufacturer during the operating life of the engine. Crankshaft deflection measurements are to be taken before and after works acceptance trials.

~~*11.1.4*~~ *11.3.4* In each case given in Table 2.11.1, all measurements conducted at the various load points ~~shall~~ are to be carried out at steady operating conditions. The readings for MCR, i.e. 100 per cent power (~~rated power at rated speed~~ rated maximum continuous power at corresponding rpm) are to be taken twice at an interval of at least 30 minutes. For all load points provision should be made for time needed by the Surveyor to carry out visual inspections.

11.3.5 Calibration records for the instrumentation are, upon request, to be presented to the attending Surveyor.

Table 2.11.1 Scope of works trials for ~~diesel~~ engines

~~*11.1.5* The data to be measured and recorded, when testing the engine at various load points, are to include all necessary parameters for the engine operation. The crankshaft deflection is to be checked when this check is required by the manufacturer during the operating life of the engine. Crankshaft deflection measurements are to be taken before (cold condition) and after (hot condition) works acceptance trials.~~

11.3.6 Alternatives to the detailed tests may be agreed between the manufacturer and LR when the overall scope of tests is found to be equivalent. The scope of the trials may be expanded depending on the engine application, service experience, or other relevant reasons.

11.3.7 Turbocharger surge margin for propulsion engines is to be demonstrated as required by 12.9.2.

~~*11.1.2*~~ *11.3.8* For electronically controlled engines:

(a) ~~works~~ integration tests in accordance with ~~1.1.6(h)~~ 1.2.1; and

(b) verification of engine configuration, *see* 4.3.2, and that the approved software quality plans, including the software configuration management process, are ~~being~~ to be applied.

Existing paragraphs 11.1.6 *to* 11.1.9 *have been renumbered* 11.3.9 *to* 11.3.12*.*

~~*11.1.10* For all stages that the engine is to be tested and where no duration is specified in Table 2.11.1, the load point is to be maintained for a sufficient period to allow pertaining values to be measured and recorded when the engine has achieved a steady operating condition.~~

~~11.2~~ 11.4 Shipboard trials

11.4.1 The purpose of the shipboard testing is to verify compatibility with power transmission and driven machinery in the system, safety, control and auxiliary systems necessary for the engine and integration of engine / shipboard control systems, as well as other items that had not been dealt with in the FAT (Factory Acceptance Testing).

~~*11.2.1*~~ *11.4.2* After ~~the conclusion of the running-in programme prescribed by the engine manufacturer~~ installation on board, engines are to undergo shipboard trials as specified in Table 2.11.2. The scope of the trials may be expanded depending on the engine application, service experience or other relevant reasons, and is to be agreed between the LR Surveyor and the Shipyard prior to testing.

Table 2.11.2 Scope of shipboard trials for ~~diesel~~ engines

Existing paragraph 11.2.2 *has been renumbered* 11.4.3*.*

~~*11.2.3*~~ *11.4.4* In addition to ~~11.2.2~~ 11.4.2, for engines driving generators for electric propulsion motors as well as auxiliaries, an operational test is to be carried out of at least 4 hours duration at a load which corresponds to 100 per cent of the electric propulsion motor(s) rated power. The astern/ahead manoeuvring capability of the propulsion system is to be demonstrated.

~~*11.2.4*~~ *11.4.5* Trials are to include demonstration of engine control, monitoring, alarm and safety system operation to confirm that they have been provided, installed and configured as intended and in accordance with the relevant requirements for main, auxiliary or emergency engines except items already verified during the works trials.

~~*11.2.5*~~ *11.4.6* For electronically controlled engines:
(a) shipboard tests in accordance with ~~1.1.6(h)~~ 1.2.1; and
(b) verification of engine configuration, *see* 4.3.2, and that the approved software quality plans, including the software configuration management process, are ~~being~~ to be applied.

Existing paragraph 11.2.6 *has been renumbered* 11.4.7*.*

~~*11.2.7 At the discretion of the attending Surveyor, the scope of the trials may be expanded in consideration of special operating conditions, such as towing, trawling, etc.*~~

11.4.8 For both manual and automatic engine control systems, acceleration and deceleration through any barred speed range, is to be demonstrated. The transit times are to be equal or less than the times stated in the approved documentation and are to be recorded. This also applies when passing through the barred speed range in reverse rotational direction, especially during the stopping test. The ship's draft and speed during all these demonstrations are to be recorded. Where a controllable pitch propeller is fitted, the pitch is also to be recorded.

11.4.9 The engine is to be checked for stable running (steady fuel index) at both upper and lower borders of the barred speed range. Steady fuel index means an oscillation range less than five per cent of the effective stroke (idle to full index).

■ *Section 12*
Component tests

Existing Section 12 has been deleted in its entirety.

■ *Section 13*
Mass produced engines

Existing Section 13 has been deleted in its entirety.

■ *Section ~~14~~ 12*
~~Turbo-chargers~~ Turbochargers

12.1 General

12.1.1 Turbochargers are to be approved, either separately or as a part of an engine. The requirements are written for exhaust gas driven turbochargers, but apply in principle also for engine driven chargers.

12.1.2 Some requirements are reduced for turbochargers manufactured on the basis of mass production methods. Mass produced turbochargers are defined as those which are produced under the following criteria:
(a) In quantity under strict quality control of material and parts, according to a quality assurance scheme acceptable to LR.
(b) By the use of jigs and automatic machine tools designed to machine parts to specified tolerances for interchangeability, and which are verified on a regular inspection basis.
(c) By assembly with parts taken from stock and requiring little or no fitting.
(d) With bench tests carried out on individual assembled turbochargers according to a specified programme.
(e) With appraisal by final examination of turbochargers selected at random after workshop testing.

12.1.3 Plans and particulars are to be submitted as required by 1.2.4.

12.1.4 Alarms and slowdowns for turbochargers are required as listed in Tables 2.7.1 and 2.7.2.

12.1.5 Turbochargers are to be designed for the operating conditions defined in Chapter 1, Section 3. The component lifetime and the alarm level for speed are to be based on 45°C air inlet temperature.

12.1.6 A Type test, *see* 14.2, is to be carried out on a standard unit taken from the assembly line and is to be witnessed by the Surveyor.

12.1.7 LR reserves the right to limit the duration of validity of approval of a mass produced turbocharger. LR is to be informed, without delay, of any change in the design of the turbocharger, in the manufacturing or control processes, in the selection of materials or in the list of subcontractors for main parts.

~~14.1~~ 12.2 Dynamic balancing

Existing paragraph 14.1.1 *has been renumbered* 12.2.1.

~~14.2~~ 12.3 Overspeed test

~~14.2.1~~ 12.3.1 All fully bladed rotor sections and impeller/inducer wheels are to be overspeed tested for three minutes at either 20 per cent above ~~the maximum permissible speed at room temperature or 10 per cent above the maximum permissible speed at the normal working temperature~~ the alarm level speed at room temperature, or 10 per cent above alarm level speed at 45°C inlet temperature when tested in the actual housing with the corresponding pressure ratio. The overspeed test may be waived for forged wheels that are individually controlled by an approved non-destructive method, this test will not be waived for wheels of the unit to be type tested.

~~14.3~~ 12.4 Mechanical running test

~~14.3.1~~ 12.4.1 ~~Turbo-chargers~~ Turbochargers are to be given a mechanical running test of 20 minutes duration at the maximum permissible speed.

~~14.3.2~~ 12.4.2 Upon application, with details of an historical audit covering previous testing of ~~turbo-chargers~~ turbochargers manufactured under an approved quality assurance scheme, consideration will be given to confining the test outlined in ~~14.3.1~~ 12.3.1 to a representative sample of turbochargers.

12.5 Containment

12.5.1 In the event of any rotor burst, the turbocharger casing is to fully contain all debris and no part may penetrate the casing of the turbocharger or escape through the air intake.

12.5.2 Containment is to be demonstrated by testing which is to be fully documented. For approval of a generic range of turbochargers, subject to satisfactory performance, only the largest unit is required to be tested. In any case, it must be demonstrated (e.g. by calculation) that the selected test unit is representative for the whole generic range.

12.5.3 The minimum test speeds for rotor burst testing is to be the same as those required for the overspeed test specified in 12.3.1.

12.5.4 Containment tests are to be performed at working temperature.

12.5.5 Calculations using a simulation model and numerical analysis to demonstrate the required containment may be accepted in lieu of the practical containment test, provided that:

(a) The numerical simulation model has been validated and its suitability/accuracy has been proven by direct comparison between calculation results and the practical containment test for a reference application (reference containment test). This test is to be performed at least once by the manufacturer for acceptance of the numerical simulation method in lieu of tests.
(b) The corresponding numerical simulation for the containment is performed for the same speeds as specified for the containment test.
(c) Material properties for high-speed deformations are to be applied in the numeric simulation. The correlation between normal properties and the properties at the pertinent deformation speed are to be substantiated.
(d) The design of the turbocharger regarding geometry and kinematics is similar to the turbocharger that was used for the reference containment test. In general, totally new designs will call for a new reference containment test.

12.6 Disk-Shaft shrinkage fit

12.6.1 For turbochargers where the disc is connected to the shaft with an interference fit, calculations are to substantiate safe torque transmission during all relevant operating conditions such as maximum speed, maximum torque and maximum temperature gradient combined with minimum shrinkage amount.

12.7 Works testing and inspection

12.7.1 LR Surveyors are to be provided with free access to the manufacturer's works to inspect at random the quality control measures and to witness the tests required by 12.7.3 to 12.7.7 as deemed necessary, and to have free access to all control records and subcontractor's certificates.

12.7.2 Each individual unit is to be tested in accordance with 12.7.4 to 12.7.7.

12.7.3 Rotating parts of the turbocharger's blower are to be marked for easy identification with the corresponding certificate. Component identification is to be in accordance with the Rules for Materials.

12.7.4 Material tests, inspection, NDE and certification of the rotating parts and casing are to be in accordance with the requirements of the Rules for Materials as applicable.

12.7.5 Pressure tests are to be carried out in accordance with Table 2.2.1. Special consideration will be given where design or testing features may require modification of the test requirements.

12.7.6 Dynamic balancing and overspeed tests are to be carried out, *see* 12.2 and 12.3.

12.7.7 A mechanical running test is to be carried out, *see* 12.4. The duration of the running test may be reduced to 10 minutes provided that the manufacturer is able to verify the distribution of defects established during the running tests on the basis of a sufficient number of tested turbochargers. For manufacturers who have facilities in their works for testing the turbochargers on an engine for which the turbochargers are intended, the bench test may be replaced by a test run of 20 minutes at overload (110 per cent of the rated output) on this engine.

12.8 Certification

12.8.1 The manufacturer is to adhere to a quality system designed to ensure that the designer's specifications are met, and that manufacturing is in accordance with the approved drawings.

12.8.2 Turbochargers are to be delivered with:

(a) For turbochargers manufactured using mass production methods as defined in 12.1.2, a manufacturer's certificate, that at a minimum cites the applicable type approval, including production assessment.

(b) For all other turbochargers, an LR certificate, that at a minimum cites the applicable type approval and the LR Quality Scheme when applicable.

12.8.3 Where the manufacturer is approved under the LR Quality Assurance for Machinery Scheme (QAM), the audits will include specific focus on:

(a) Chemical composition of material for the rotating parts.
(b) Mechanical properties of the material of a representative specimen for the rotating parts and the casing.
(c) UT and crack detection of rotating parts.
(d) Dimensional inspection of rotating parts.
(e) Rotor dynamic balancing.
(f) Hydraulic testing of cooling spaces in accordance with Table 2.2.1.
(g) Overspeed test of all compressor disks as per 12.3.1.

■ *Section 15*
Mass produced turbo-chargers

Existing Section 15 has been deleted in its entirety.

■ *Section ~~16~~ 13*
Air compressors

Existing sub-Sections 16.1 *and* 16.2 *have been renumbered* 13.1 *and* 13.2.

~~16.3~~ 13.3 Materials

Existing paragraphs 16.3.1 *and* 16.3.2 *have been renumbered* 13.3.1 *and* 13.3.2.

~~*16.3.3* Materials for components are to be tested as indicated in 2.2.~~

~~*16.3.4*~~ *13.3.3* For compressors crankshafts with a calculated crank pin diameter equal to or greater than 50 mm, ~~they are to be manufactured and tested in accordance with the requirements of the LR Rules for Materials~~ materials for components are to be tested as indicated in 2.2. For calculated crank pin diameters less than 50 mm, a manufacturers' certificate may be accepted, *see* Ch 1,3.1.3(c) of the ~~LR~~ Rules for Materials.

Existing sub-Sections 16.4 *to* 16.6 *have been renumbered* 13.4 *to* 13.6.

~~16.7~~ 13.7 Crankcase relief valves

~~*16.7.7*~~ *13.7.7* Plans showing details and arrangements of the crankcase relief valves are to be submitted for approval, *see* ~~1.1~~ 1.2.

Existing sub-Sections 16.8 *to* 16.10 *have been renumbered* 13.8 *to* 13.10.

■ *Section ~~17~~ 14*
Type testing – General

Existing sub-Sections 16.1 *and* 16.2 *have been renumbered* 13.1 *and* 13.2.

~~17.1~~ 14.1 Engines

Existing paragraph 17.1.1 *has been renumbered* 14.1.1.

~~*17.1.2*~~ *14.1.2* ~~Guidelines~~ Requirements for type testing of engines ~~will be supplied on application~~ are contained within the Lloyd's Register Type Approval System, Test Specification No. 4 – *Reciprocating Internal Combustion Engines and Associated Ancillary Equipment*. In all cases the type test specification is to be agreed with LR.

14.1.3 Type testing specifications for other auxiliary systems are to be submitted for approval if they are to be tested separately from the engine.

~~*17.1.3*~~ *14.1.4* Wherever practical, type tests are to be conducted with the engine control systems operational in the approved configuration, *see* 1.1 and 4.3.2. Configuration management documents that satisfy the requirements of ISO 10007 or an equivalent national or international standard, are to be reviewed at testing for validity and referenced in the type test report.

14.1.5 In addition to type testing against the requirements of Test Specification No. 4, engines may also be submitted for approval against recognised international or national standards. Where this additional testing and appraisal is carried out satisfactorily it will be stated on the Type Approval Certificate.

~~*17.1.4* An engine type is defined in terms of:~~
~~• basic engine data: e.g. bore, stroke~~
~~• working cycle: 2 stroke, 4 stroke~~
~~• cylinder arrangement: in-line, vee~~
~~• cylinder rating~~
~~• fuel supply: e.g. direct, or indirect injection, dual fuel~~
~~• gas exchange: natural aspiration, pressure charging arrangement.~~

~~*17.1.5* Where an engine type has subsequently proved satisfactory in service with a number of applications a maximum uprating of 10 per cent may be considered without a further complete type test.~~

~~*17.1.6* A type test will be considered to cover engines of a given design for a range of cylinder numbers in a given cylinder arrangement.~~

Existing sub-Section 17.2 *has been deleted in its entirety.*

~~17.3~~ 14.2 ~~Turbo-chargers~~ Turbochargers

~~*17.3.1* A type test is to consist of a hot gas running test of at least one hour duration at the maximum permissible speed and maximum permissible temperature. Following the test the turbo-charger is to be completely dismantled for examination of all parts.~~

~~*17.3.2* Alternative arrangements will be specially considered.~~

14.2.1 Requirements for type testing of turbochargers are contained within the Lloyd's Register Type Approval System, *Test Specification No. 4 – Reciprocating Internal Combustion Engines and Associated Ancillary Equipment*. In all cases the type test specification is to be agreed with LR.

14.3 Crankcase explosion relief valves

14.3.1 Requirements for type testing of crankcase explosion relief valves are contained within the Lloyd's Register Type Approval System, *Test Specification No. 4 – Reciprocating Internal Combustion Engines and Associated Ancillary Equipment*. In all cases the type test specification is to be agreed with LR.

14.3.2 The test specification is only applicable to explosion relief valves fitted with flame arresters. Where internal oil wetting of a flame arrester is a design feature of an explosion relief valve, alternative testing arrangements that demonstrate compliance with these requirements may be proposed by the manufacturer. The alternative testing arrangements are to be submitted to LR for appraisal.

14.4 Crankcase oil mist detection system

14.4.1 Requirements for type testing of crankcase oil mist detection systems are contained within the Lloyd's Register Type Approval System, *Test Specification No. 4 – Reciprocating Internal Combustion Engines and Associated Ancillary Equipment*. In all cases the type test specification is to be agreed with LR.

14.4.2 This test specification is also applicable to oil mist detection systems intended for gear cases.

14.4.3 The approval of one type of detection equipment may be used to qualify other devices having identical construction details. Proposals are to be submitted for consideration.

14.4.4 Acceptance of crankcase oil mist detection equipment is at the discretion of LR based on the appraisal of plans and particulars and the test house report of the results of type testing. *See* 1.2.6.

■ *Section 18*
Type testing procedure for crankcase explosion relief valves

Existing Section 18 has been deleted in its entirety.

■ *Section 19*
Mass produced engines

Existing Section 19 has been deleted in its entirety.

Part 5, Chapter 6

Main Propulsion Shafting

Effective date 1 July 2015

■ *Section 3*
Design

3.12 Sternbushes

3.12.9 ~~Two temperature sensors or other approved arrangements that can, where practicable, be replaced without dry-docking or divers are to be provided to ascertain the sterntube aft end bearing temperature.~~ Means for ascertaining the temperature of the sternbush bearings are to be provided, e.g. monitoring of the temperature of the oil in the sterntube.

■ *Section 4*
Design

4.1 Screwshaft Condition Monitoring (SCM)

4.1.1 For vessels where the ShipRight descriptive note SCM (Screwshaft Condition Monitoring) is requested the requirements in either 4.1.2 or 4.1.3 are to be satisfied.

4.1.2 Oil lubricated bearings:

(a) Arrangements are to be provided to allow analysis of the lubricating oil. Oil samples are to be taken under service conditions and are to be representative of the oil within the sterntube, sampling arrangements are to meet the requirements of Ch 14, 8.12.6.

(b) Bearing temperature sensor arrangement is to be designed with either:
  (i) sufficient redundancy in the event of failure of one sensing element and/or its associated cabling; or
  (ii) means to allow replacement of a damaged sensor without requiring dry-docking or divers.

(c) Facilities are to be provided for measurement of bearing weardown.

(d) Approved oil glands that are capable of being replaced without removal of the propeller or withdrawal of the screwshaft are to be fitted.

4.1.3 Water lubricated bearings:

(a) An approved means of monitoring and recording variations in the flow rate of lubricating water using two independent sensors is to be provided.

(b) An approved means of monitoring and recording variations in the shaft power transmission is to be provided.

(c) The maximum permitted weardown of the sternbush is to be indicated by the manufacturer. The maximum weardown allowance is to include both the absolute maximum permitted weardown and the weardown at which it is recommended to carry out an inspection and maintenance. An approved means of monitoring bearing wear is to be provided. An alignment analysis considering both the newly installed clearance and the proposed absolute maximum allowable weardown, demonstrating that the system will operate satisfactorily within these two limits, is to be submitted and approved.

(d) For open loop systems the manufacturer is to submit information regarding the required standard of lubricating water filtration and lubricating water filters or separators are to be fitted which are able to achieve this requirement. The lubricating water supply is to be fitted with either continuous water sediment measuring equipment; turbidity monitoring equipment or an LR approved extractive sampling and testing procedure.

(e) Where a closed cycle water system is used, arrangements are to allow analysis of the water for at least the following parameters:
  (i) Chloride content
  (ii) Bearing material and metal particles content.
  Water samples are to be representative of the water circulating within the sterntube.

(f) The shaft is to either be constructed of corrosion resistant material or protected with a corrosion resistant protective liner or coating approved by LR. Where a protective liner or coating is used, this is to meet the requirements of Pt 5, Ch 6,3.9 and a means of assessing the condition of this liner is to be submitted and approved.

(g) Glands are to be capable of being replaced without withdrawal of the screwshaft.

(h) There is to be a shaft starting/clutch engagement block to inhibit starting the shaft until lubricating water flow has been established. This is to only act as a starting block; for lubricating water flow alarm *see* Table 6.4.1.

(j) Alternative arrangements are subject to special consideration.

Table 6.4.1 Alarm and safeguard for water lubricated bearings

Item	Alarm	Note
Lubricating water flow	Low	*See* 4.1.3(h)

Part 5, Chapter 8

Shaft Vibration and Alignment

Effective date 1 July 2015

■ *Section 5* Shaft alignment

5.2 Particulars to be submitted for approval – Shaft alignment calculations

5.2.1 Shaft alignment calculations are to be submitted to LR for approval for the following shafting systems:

(a) All geared installations, where the screwshaft has a diameter of 300 mm or greater in way of the aftmost bearing~~, except for multiple input/single output geared installations, in which case all such installations will be submitted for approval~~.

(b) All geared installations with multiple input/single output, regardless of shaft diameter.

(~~b~~c) All direct drive installations which incorporate ~~3~~ three or fewer bearings supporting the intermediate and screwshaft aft of the prime mover.

(~~c~~d) Where prime movers in a direct drive installation or shaftline bearings are installed on resilient mountings.

(~~d~~e) All systems where the screwshaft has a diameter of 800 mm or greater in way of the aftmost bearing.

Part 5, Chapter 9

Podded Propulsion Units

Effective date 1 July 2015

■ *Section 3* Functional capability

3.1 General

3.1.2 The main steering arrangements are to be operated by power and capable of changing the direction of the ship's ~~directional control system~~ podded propulsion units from one side to the other at declared steering angle limits at an average rotational speed of not less than 0,4 rev/min with the ship initially operating at its maximum ahead service speed.

3.1.4 The auxiliary steering arrangements are to be:

(a) Capable of changing the direction of the ship's ~~directional control system~~ podded propulsion units from one side to the other at declared steering angle limits at an average rotational speed of not less than 0,083 rev/min, with the ship running ahead at one half of the maximum ahead service speed or 7 knots, whichever is the greater.

(b) ~~For all ships, operated by power where necessary to meet the requirements of (a) and in any ship having power more than 2,500 kW propulsion power per thruster unit~~ Operated by power for ships having propulsion power of more than 2500 kW per podded propulsion unit and for all ships, where it is necessary, to meet the requirements of (a).

Part 5, Chapter 9

■ *Section 6*
Machinery design and construction requirements

6.6 Steering system

6.6.1 The requirements of Ch~~apter~~ 19, Sections 1, 2, 3, 6, 7 and 8 are to be complied with where applicable. *See also* 3.1. The requirements of Ch 19, 2.1.2(b) and (c) are addressed by 3.1.2 and the requirements of Ch 19, 2.1.3(b) and (c) are addressed by 3.1.4.

6.6.3 For vessels with more than one steerable podded propulsion unit, the requirement for auxiliary steering arrangements in Ch 19,2 is to be achieved by equipping each of the ~~pod~~ podded propulsion units with its own dedicated and independent steering gear control system and power actuating system. Consideration will be given to alternative arrangements providing equivalence can be demonstrated.

Part 5, Chapter 10

Steam Raising Plant and Associated Pressure Vessels

Effective date 1 July 2015

■ *Section 15*
Mountings and fittings for cylindrical and vertical boilers, steam generators, pressurised thermal liquid and pressurised hot water heaters

15.2 Safety valves

15.2.8 For each safety valve, an individual unrestricted drain is to be provided. The drain pipe is to be fitted to the lowest part of the discharge side of the safety valve; it is to be below the level of the valve sea and is to be independently led with a continuous fall to a place where the high temperature steam and/or condensate can discharge, visibly clear of the boilers and where it cannot cause injury. No valves or cocks are to be fitted to these drain pipes. The bore of the drain pipes is not to be less than 19 mm. Where a drain pipe of 19 mm is impracticable, smaller drain pipes may be considered.

Part 5, Chapter 12

Piping Design Requirements

Effective date 1 July 2015

■ *Section 4*
Cast iron

4.2 Grey cast iron

4.2.3 Grey cast iron is not to be used for the following:

- Pipes for steam systems and fire extinguishing systems.
- Pipes, valves and fittings for boiler blow-down systems and other piping systems subject to shock or vibration.
- Ship-side valves and fittings, *see* Ch 13,2.5.
- Valves fitted on the collision bulkhead, *see* Ch 13,3.5.
- Bilge lines in tanks.
- ~~Pipes and fittings~~ Piping system components in flammable oil systems where the design pressure exceeds 7 bar or the design operating temperature is greater than 60°C.
- Valves fitted to tanks containing flammable oil under static pressure.
- Valve chests and fittings for starting air systems, *see* Ch 2,8.3.4.
- Manifolds and their valves and fittings on tankers that connect to cargo-handling hoses.

Part 5, Chapter 13

Ship Piping Systems

Effective date 1 July 2015

■ *Section 7*
Piping systems and their fittings

7.10 Bilge pipes in way of deep tanks

7.10.1 In way of deep tanks, bilge pipes should preferably be led through pipe tunnels but, where this is not done, the pipes are to be of steel, having a wall thickness in accordance with Table 12.2.4 in Chapter 12, with welded joints or heavy flanged joints. The number of joints is to be kept to a minimum. Consideration will be given to pipes made from materials other than steel, *see also* Ch 12,5.

Part 5, Chapter 16

Water Jet Systems

Effective date 1 July 2015

■ *Section 3*
Design requirements

3.7 Nozzle/steering arrangements

3.7.1 In general, the steering systems and components are to comply with the requirements of Chapter 19. The requirements of Ch 19,2.1.2(b) and (c) are addressed by 3.7.3 and the requirements of Ch 19,2.1.3(b) and (c) are addressed by 3.7.4.

3.7.3 The main steering arrangements are to be operated by power and capable of changing the direction of the ship's ~~directional control system~~ water jet nozzles from one side to the other at declared steering angle limits at an average rotational speed of not less than 0,4 rev/min, with the ship running ahead at maximum ahead service speed.

3.7.4 The auxiliary steering arrangements are to be:

(a) Capable of changing the direction of the ship's ~~directional control system~~ water jet nozzles from one side to the other at declared steering angle limits at an average rotational speed of not less than 0,083 rev/min, with the ship running ahead at one half of the maximum ahead service speed or 7 knots, whichever is the greater.

(b) ~~For all ships, operated by power where necessary to meet the requirements of (a) and in any ship having power more than 2,500 kW propulsion power per thruster unit.~~ Operated by power for ships having propulsion power of more than 2500 kW per water jet unit and for all ships, where it is necessary, to meet the requirements of (a).

Part 5, Chapter 19

Steering ~~Gear~~ Arrangements

Effective date 1 July 2015

■ *Section 1*
General

1.1 Application

1.1.1 The requirements of this Chapter apply to the design and construction of steering ~~gear~~ arrangements.

■ *Section 2*
Performance

2.1 General

2.1.1 Unless the main steering arrangements for ship directional control comprise two or more identical power units, in accordance with 2.1.4 or 8.1.1, every ship is to be provided with main steering arrangements and auxiliary steering arrangements in accordance with the requirements of the Rules. The main ~~steering arrangements~~ and ~~the~~ auxiliary steering arrangements are to be so arranged that the failure of one of them will not render the other one inoperative.

2.1.6 Where the steering ~~gear is so arranged~~ arrangements are such that more than one power or control system can be simultaneously operated, the risk of hydraulic locking caused by a single failure is to be considered.

■ *Section 5*
Electric power circuits, electric control circuits, monitoring and alarms

5.1 Electric power circuits

5.1.2 Where steering gear motor circuits are supplied by converters, consideration will be given to arrangements that provide an equivalent level of safety, reliability, availability and indication to those specified in 5.1.1, provided that technical justification is submitted.

■ *Section 6*
Emergency power

6.1 General

6.1.1 Where the rudder stock is required to be over 230 mm diameter in way of the tiller, excluding strengthening for navigation in ice, or for ships fitted with podded propulsion units or water jet systems where the power per propulsion unit exceeds 2,500 kW, an alternative power supply, sufficient at least to supply the steering arrangements which comply with the requirements of 2.1.3 and also its associated control system and the steering angle indicator, ~~shall~~ is to be provided automatically, within 45 seconds, either from the emergency source of electrical power or from an independent source of power located in the steering gear compartment. This independent source of power shall be used only for this purpose.

Part 5, Chapter 20

Azimuth Thrusters

Effective date 1 July 2015

■ *Section 2*
Performance

2.1 General

2.1.3 In general, the steering systems and components are to comply with the requirements of Ch 19. The requirements of Ch 19,2.1.2(b) and (c) are addressed by 2.1.5 and the requirements of Ch 19,2.1.3(b) and (c) are addressed by 2.1.6.

~~*2.1.3*~~ *2.1.4* In addition to the requirements of ~~Chapter~~ Ch 19, the azimuthing mechanism is to be capable of a rotational speed of not less than 1,5 rev/min.

~~*2.1.4*~~ *2.1.5* The main steering arrangements are to be operated by power and capable of changing the direction of the ship's ~~directional control system~~ azimuth thrusters from one side to the other at declared steering angle limits at an average rotational speed of not less than 0,4 rev/min, with the ship running ahead at maximum ahead service speed.

~~*2.1.5*~~ *2.1.6* The auxiliary steering arrangements are to be:

(a) Capable of changing the direction of the ship's ~~directional control system~~ azimuth thrusters from one side to the other at declared steering angle limits at an average rotational speed of not less than 0,083 rev/min, with the ship running ahead at one half of the maximum ahead service speed or 7 knots, whichever is the greater.

(b) ~~For all ships, operated by power where necessary to meet the requirements of (a) and in any ship having power more than 2,500 kW propulsion power per thruster unit.~~ Operated by power for ships having propulsion power of more than 2500 kW per thruster unit and for all ships, where it is necessary, to meet the requirements of (a).

Part 5, Chapter 24

Emissions Abatement Plant for Combustion Machinery

Effective date 1 July 2015

■ *Section 5*
Hull construction

5.1 General

5.1.4 Where independent tanks are used for chemical substances, these are to be ~~bunded~~ arranged so as to contain spillage. ~~The bund~~ This may be achieved by using a double skinned storage tank, by means of a spill containment bund or by placing the tank in a dedicated compartment. Where a bund is to be used, it is to comply with the following:

(a) the bund is dimensioned so as to contain the maximum contents of the tank at the angles of inclination required for main and auxiliary machinery in Table 1.3.2 in Chapter 1; or

(b) there is a drain arrangement meeting the requirements of 5.1.6; ~~or~~

~~(c)~~ if the tank is located in a dedicated compartment ~~containing~~ then the compartment is to contain no equipment other than that required by the tank with permanent access and floor plates positioned above the liquid level if the tank were to discharge its full contents into the compartment. Any valves, equipment and emergency stop functions are to be operable from outside this compartment and are to meet the requirements of 5.2.

Tanks and spill containment arrangements are to be fitted with alarms and safeguards, in accordance with Table 9.1.9.

5.1.7 Chemical tanks containing substances which are categorised as a safety hazard in Chapter 17 of the Rules for Ships for Liquid Chemicals (designated by letter "S" in column d) are not to be located in the same space as essential machinery and equipment.

~~**5.4 Cofferdams**~~

~~*5.4.1* Cofferdams are to be sited as required by the Rules for Ships for Liquid Chemicals, as applicable, segregating any spaces in which chemicals, substances or effluents are stored or retained in bulk.~~

Existing sub-Sections 5.5 *to* 5.7 *have been renumbered* 5.4 *to* 5.6.

Part 6, Chapter 2

Electrical Engineering

Effective date 1 July 2015

■ *Section 1*
General requirements

1.3 General

1.3.8 Details of, and arrangements in, the spaces in which the lighting is required to satisfy the requirements of Section 23 Ergonomic Lighting Design (EDL) optional notation.

■ *Section 6*
System design – Protection

6.3 Protection against overload

6.3.2 Fuses of a type intended for short-circuit protection only (e.g.~~,~~ ~~fuse links~~ high-voltage fuses or fuses complying with IEC 60269-1: *Low-voltage fuses – Part 1: General requirements*, of type 'a') are not to be used for overload protection.

6.8 Protection of generators

6.8.5 ~~Generators~~ All high-voltage generators and low-voltage generators having a capacity of 1500 kVA or above are to be equipped with a protective device which, in the event of a short-circuit in the generator or in the cables between the generator and its circuit-breaker, will instantaneously open the circuit-breaker and de-excite the generator.

■ *Section 7*
Switchgear and controlgear assemblies

7.1 General requirements

7.1.1 Switchgear and controlgear assemblies and their components are to comply with ~~one of~~ the following standards, as appropriate for the nominal voltage and, amended where necessary for ambient temperature and other environmental conditions:

(a) IEC 61439: *Low-voltage switchgear and controlgear assemblies* (relevant parts);

(b) IEC 62271-200: *High-voltage switchgear and controlgear – Part 200: AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV*;

(c) IEC 62271-201: *High-voltage switchgear and controlgear — Part 201: AC insulation-enclosed switchgear and ~~control gear~~ controlgear for rated voltages above 1 kV and up to and including 52 kV*;

(d) IEC 60092-503: *Electrical installations in ships – Part 503: Special features – AC supply systems with voltages in the range of above 1 kV up to and including 15 kV;*

(~~d~~e) IEC 60255: *Measuring relays and protection equipment*; or

(~~e~~f) an acceptable and relevant National Standard.

In addition, the requirements of 7.2 to 7.19 are to be complied with.

7.6 Degree of protection

7.6.3 Segregation between low-voltage and high-voltage circuits and equipment installed within common assemblies is to be in accordance with IEC 62271-1: *High-voltage switchgear and controlgear – Part 1: Common specifications*.

■ *Section 10*
Converter equipment

10.1 Transformers

10.1.2 Transformers are to comply with the requirements of ~~IEC 60076 (all parts): *Power transformers*, or an acceptable and relevant National Standard amended where necessary for ambient temperature, *see* 1.9.~~ the following standards:

(a) IEC 60076 (all parts): *Power transformers* (all parts);
(b) IEC 60092-503: *Electrical installations in ships – Part 503: Special features – AC supply systems with voltages in the range of above 1 kV up to and including 15 kV;* or
(c) an acceptable and relevant National Standard amended where necessary for ambient temperature, *see* 1.9.

■ *Section 11*
Electric cables, optical fibre cables and busbar trunking systems (busways)

11.8 Installation of electric cables

11.8.16 ~~High voltage~~ High-voltage electric cables are to be segregated ~~as far as is practicable~~ from electric cables operating at lower voltages.

■ *Section 23*
Ergonomic Lighting Design – ELD optional notation

23.1 Objectives

23.1.1 The requirements in this Section are applicable where the optional class notation for ergonomic lighting design is requested.

23.1.2 The design and installation of indoor lighting is to facilitate visual task performance, safety and visual comfort. In order to achieve this goal the requirements of 23.2 to 23.6 are to be complied with.

23.1.3 The requirements in this Section do not address emergency or navigational lighting.

23.2 Positioning and installation

23.2.1 In order to meet the ergonomic requirements of 23.3 to 23.6 the positioning and installation of lights is to comply with 23.2.2 to 23.2.11.

23.2.2 Natural lighting through the use of windows and doors is to be provided as far as practicable.

23.2.3 Lights are to be positioned, as far as practicable, in the same horizontal plane and arranged symmetrically to produce a uniform level of illumination.

23.2.4 Lights are to be positioned so as to reduce bright spots and shadows as far as possible.

23.2.5 Lights are to be positioned taking account of structures such as beams and columns etc., so the lighting is not blocked by these items.

23.2.6 Lights are not to be positioned in locations which would result in limited illumination.

23.2.7 Lights are to be positioned taking account of air-conditioning vents or fans, fire detectors, water sprinklers etc., so the lighting is not blocked by these items.

23.2.8 The position of lights configured to strips or tubes is, as far as practicable, to be at right angles to an operator's line of sight while the operator is located at their typical duty station.

23.2.9 Any physical hazards that provide a risk to operator safety are to be appropriately illuminated.

23.2.10 The positioning of lights is to consider the transfer of heat to adjacent surfaces.

23.2.11 Lights are to be positioned in locations that are easy to reach for lamp replacement or maintenance.

23.3 Luminance distribution

23.3.1 In order to provide even, fatigue-free illumination the requirements of 23.3.2 to 23.3.6 are to be complied with.

23.3.2 The light levels falling on the plane in which a task is performed are to be suitable for the type of task, i.e. they are to consider the variation in the working planes.

23.3.3 Sharp contrasts in illumination levels across an operator task or working plane are to be avoided, as far as possible.

23.3.4 Sharp contrasts in illumination levels between an operator task area and the immediate surround and general background area are to be avoided, as far as possible.

23.3.5 Where required, local lighting for operational tasks is to be provided in addition to general lighting.

23.3.6 Lighting is to be free of perceived flicker.

23.4 Glare

23.4.1 In order to minimise glare (to avoid dazzle, discomfort and fatigue) the requirements of 23.4.2 to 23.4.6 are to be complied with.

23.4.2 Lights are to be positioned so as to reduce, as far as possible, glare or high brightness reflections from working and display surfaces.

23.4.3 Lights are to be positioned so as to provide even illumination and minimal glare on controls, displays and indicators.

23.4.4 Where necessary, suitable blinds and shading devices are to be used to prevent glare.

23.4.5 Surfaces are to have a non-reflective or matt finish in order to reduce the likelihood of indirect glare.

23.4.6 Where a transparent cover is fitted over a control, display or indicator, it is to be designed to minimise reflections.

23.5 Location of lighting controls and outlets

23.5.1 In order to allow convenient use of lighting the requirements of 23.5.2 to 23.5.6 are to be complied with.

23.5.2 The lighting system is to be easily maintained and operated by personnel.

23.5.3 Lighting is to be controllable locally in accommodation and working areas, except where this conflicts with safety requirements.

23.5.4 Light switches are to be fitted in safe positions for personnel.

23.5.5 The mounting height of switches is to be such that personnel can reach switches with ease.

23.5.6 Power outlets are to be provided where temporary, local, task lighting will be required, except in hazardous areas.

23.6 Night vision

23.6.1 In order to maintain night vision and facilitate safety during hours of darkness the requirements of 23.6.2 to 23.6.4 are to be complied with.

23.6.2 Lighting on the ship’s superstructure is to be directed away from, and shaded to prevent direct illumination of, the bridge windows and lookout points.

23.6.3 Instrument lighting is to be such that the operator can read dials and indicators without impediment of night vision.

23.6.4 Lighting of instruments, keyboards and controls is to be adjustable down to zero, except for the lighting of alarm and warning indicators and the controls of dimmers, which are to remain readable.

Part 7, Chapter 11

Arrangements and Equipment for Environmental Protection (ECO Class Notation)

Effective date 1 July 2015

■ *Section 1*
General requirements

1.5 Information to be submitted

(*Part only shown*)

1.5.5 Information and plans:

(u) Lubricants' technical data sheet(s) and letter/Statement(s) from original equipment manufacturer(s) for each oil-to-sea interface where EAL's are applied (e.g. stern tube) to declare compatibility with the specified Environmentally Acceptable Lubricant(s) and detailed drawings of the component(s) 'interfacing' with such lubricants (supplementary character **EAL** only).

Existing sub-paragraphs (u) *to* (ab) *have been renumbered* (v) *to* (ac).

■ *Section 2*
Core requirements

2.1 General

2.1.5 High speed craft, as defined in LR's *Rules and Regulations for the Classification of Special Service Craft*, and non-tank ships less than 400 gross tonnes, will be the subject of special consideration.

2.10 Sewage treatment

2.10.2 The capacity of the sewage treatment system, is to be sufficient for the maximum number of persons on board. Where 'black water' only is treated, the minimum capacity is to be 115 litres/person/day for a conventional flushing system or 15 litres/person/day for a vacuum system. Where both 'black water' and 'grey water' are treated, an additional allowance of ~~300~~ 135 litres per person, per day ~~(made up from 85 litres of galley grey water, 40 litres of laundry grey water and 175 litres of cabin and domestic grey water)~~ is to be made.

■ *Section 3*
Supplementary characters

3.5 Environmentally Acceptable Lubricants - EAL character

3.5.1 For assignment of the **EAL** character, the ship shall use Environmentally Acceptable Lubricants (EAL) that comply with the EPA criteria, as defined in Section 2.2.9 of the 2013 Vessle General Permit (VGP).

3.5.2 Ships shall have on board a 'Report of Environmentally Acceptable Lubricants' and a Statement of Fact issued by LR or equivalent documentation issued by another IACS member.

3.5.3 All the planned actions mentioned in the relevant Sections of the Report shall be completed, as appropriate, for the assignment of the supplementary character.

~~3.5~~ 3.6 Energy Efficiency Design Index – EEDI-1, EEDI-2, EEDI-3 characters

~~*3.5.3*~~ *3.6.3* ~~For ships constructed before 1 January 2015, t~~The **EEDI-1** character will be assigned to 'new ships' (according to MARPOL Annex VI, Chapter 1, Regulation 2.23) to which EEDI Phase 0 is applicable when the 'attained' EEDI is less than or equal to the EEDI Phase 1 requirement (i.e.~~,~~ 10 per cent less than the applicable reference line).

~~*3.5.4*~~ *3.6.4* ~~For ships constructed before 1 January 2020, t~~The **EEDI-2** character will be assigned to 'new ships' (according to MARPOL Annex VI, Chapter 1, Regulation 2.23) to which EEDI Phase 0 or Phase 1 is applicable when the 'attained' EEDI is less than or equal to the EEDI Phase 2 requirement (i.e.~~,~~ 15 per cent less than the applicable reference line for general cargo ships and refrigerated cargo ships or 20 per cent less than the applicable reference line for other ship types).

~~*3.5.5*~~ *3.6.5* ~~For ships constructed before 1 January 2025, t~~The **EEDI-3** character will be assigned to 'new ships' (according to MARPOL Annex VI, Chapter 1, Regulation 2.23) to which EEDI Phase 0, Phase 1 or Phase 2 is applicable when the 'attained' EEDI is less than or equal to the EEDI Phase 3 requirement (i.e.~~,~~ 30 per cent less than the applicable reference line).

Existing sub-Sections 3.6 *and* 3.7 *have been renumbered* 3.7 *and* 3.8*.*

~~3.8~~ 3.9 Grey water – GW character

~~*3.8.1*~~ *3.9.1* For assignment of the **GW** character ~~where a plant for the treatment of grey water is~~ a dedicated plant for the treatment of grey water is to be installed, and the plant discharge effluent is to meet the standards specified in ~~3.8.2~~ 3.9.2 or ~~3.8.3~~ 3.9.3, as applicable. The **GW** character will also be assigned where grey water is retained ~~onboard~~ on board in dedicated holding tank(s) for discharge ashore, subject to the requirements specified in ~~3.8.4~~ 3.9.4 to ~~3.8.9~~ 3.9.9 being met.

~~*3.8.4*~~ *3.9.4* As an alternative to treatment, where grey water is retained ~~onboard~~ on board in dedicated holding tank(s) for discharge ashore ~~the holding tank(s) is to be of adequate capacity taking into account the operation of the ship, the number of persons on board and other relevant factors~~ an additional allowance of 135 litres per person per day is to be made in the capacity of the holding tanks. Each tank is to be fitted with a means to open the tank, means to verify visually the contents of the tank and a high level alarm. *See* 2.11.2.

~~*3.8.5*~~ *3.9.5* ~~Means~~ Where grey water is retained on board in dedicated holding tanks, means are to be provided to aerate the tanks to prevent the development of anaerobic conditions, taking into account IMO MSC/Circ.648 *Guidelines for the Operation, Inspection and Maintenance of Ship Sewage Systems*.

Existing sub-Sections 3.9 *to* 3.16 *have been renumbered* 3.10 *to* 3.17*.*

Cross-References

Section numbering in brackets reflects any Section renumbering necessitated by any of the Notices that update the current version of the Rules for Ships.

Part 1, Chapter 3

17.3.6 Reference to Part 1, Chapter 3, 17.3.3(f) *now reads* Part 5, Chapter 6, 4.1.3(f)

Part 5, Chapter 2

7.6.7 Reference to Part 5, Chapter 2, 16.4 *now reads* Part 5, Chapter 2, 13.4

Table 2.7.2 Reference to Part 5, Chapter 2, 16 *now reads* Part 5, Chapter 2, 13

9.1.5 Reference to Part 5, Chapter 2, 1.1.5 *now reads* Table 2.1.1

10.1.4 Reference to Part 5, Chapter 2, 18 *now reads* Part 5, Chapter 2, 14.3

10.1.7 Reference to Part 5, Chapter 2, 1.1 *now reads* Part 5, Chapter 2, 1.2

10.8.1 Reference to Part 5, Chapter 2, 19 *now reads* Part 5, Chapter 2, 14.4

Table 2.11.2 Reference to Part 5, Chapter 2, 11.1.7 *now reads* Part 5, Chapter 2, 11.3.10

Table 2.11.2 Reference to Part 5, Chapter 2, 11.2.3 *now reads* Part 5, Chapter 2, 11.4.4

Table 2.11.2 Reference to Part 5, Chapter 2, 16 *now reads* Part 5, Chapter 2, 13

16.3.2 *now* 13.3.2 Reference to Part 5, Chapter 2, 16.3.1 *now reads* Part 5, Chapter 2, 13.3.1

16.4.1 *now* 13.4.1 References to Part 5, Chapter 2, 16.4.2 to 16.4.6 *now read* Part 5, Chapter 2, 13.4.2 to 3.4.6

16.4.4 *now* 13.4.4 Reference to Part 5, Chapter 2, 16.4.2 *now reads* Part 5, Chapter 2, 13.4.2

16.4.5 *now* 13.4.5 Reference to Part 5, Chapter 2, 16.4.2 *now reads* Part 5, Chapter 2, 13.4.2

16.7.6 *now* 13.7.6 Reference to Part 5, Chapter 2, 16.7.3 *now reads* Part 5, Chapter 2, 13.7.3

16.7.7 *now* 13.7.7 Reference to Part 5, Chapter 2, 1.1 *now reads* Part 5, Chapter 2, 1.2

17.1.3 *now* 14.1.4 Reference to Part 5, Chapter 2, 1.1 *now reads* Part 5, Chapter 2, 1.2

Part 5, Chapter 14

10.1.3 Reference to Part 5, Chapter 2, 16 *now reads* Part 5, Chapter 2, 13

10.2.4 Reference to Part 5, Chapter 2, 16 *now reads* Part 5, Chapter 2, 13

Part 5, Chapter 24

6.1.2 Reference to Part 5, Chapter 24, 5.5 *now reads* Part 5, Chapter 24, 5.4

6.1.2 Reference to Part 5, Chapter 24, 5.6 *now reads* Part 5, Chapter 24, 5.5

Part 6, Chapter 2

1.3.5 Reference to Part 5, Chapter 2, 1.1.5 *now reads* Table 2.1.1

Part 7, Chapter 11

1.5.5(z) *now* 1.5.5(aa) Reference to Part 7, Chapter 11, 3.16.3 *now reads* Part 7, Chapter 11, 3.17.3

3.8.1 *now* 3.9.1 Reference to Part 7, Chapter 11, 3.8.2 *now reads* Part 7, Chapter 11, 3.9.2

3.8.1 *now* 3.9.1 Reference to Part 7, Chapter 11, 3.8.3 *now reads* Part 7, Chapter 11, 3.9.3

3.8.1 *now* 3.9.1 References to Part 7, Chapter 11, 3.8.4 to 3.8.9 *now read* Part 7, Chapter 11, 3.9.4 to 3.9.9

3.15.1 *now* 3.16.1 References to Part 7, Chapter 11, 3.15.2 to 3.15.8 *now read* Part 7, Chapter 11, 3.16.2 to 3.16.8

3.16.1 *now* 3.17.1 Reference to Part 7, Chapter 11, 3.16.2 *now reads* Part 7, Chapter 11, 3.17.2

3.16.1 *now* 3.17.1 Reference to Part 7, Chapter 11, 3.16.3 *now reads* Part 7, Chapter 11, 3.17.3

3.16.2 *now* 3.17.2 Reference to Part 7, Chapter 11, 3.15.2 *now reads* Part 7, Chapter 11, 3.16.2

Update to current version of the Rules for Inland Water Ways.

Part 5, Chapter 2

9.1.5 Reference to Part 5, Chapter 2, 16 *now reads* Part 5, Chapter 2, 13

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